

SECTION 230010

MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL

- A. The requirements of the General Conditions, the Supplementary General Conditions, and the applicable portions of Division 1 shall apply to this section of the specifications.

1.2 SCOPE

- A. Provide and install complete and operating heating, ventilating, air conditioning and plumbing systems in accordance with these specifications and accompanying contract drawings. This shall include all required labor, materials, equipment, and supervision.
- B. The work shall include but is not limited to the following systems, equipment, materials, and labor for a complete system including the following:
 - 1. Diffusers, Registers & Grilles
 - 2. Ductwork System
 - 3. Exhaust Fans
 - 4. Rooftop AC Units
 - 5. VAV Boxes
 - 6. Electric Duct Heaters
 - 7. Electric Wall Heaters, Cabinet Heaters
 - 8. Gas Piping
 - 9. ATC Control System
 - 10. New Plumbing Fixtures and Equipment
 - 11. Sanitary Waste, Vent and Domestic Water Piping
 - 12. Medical Gas Piping System
 - 13. Medical Vacuum System
 - 14. New Condensate Drainage System
 - 15. Fire Protection System
 - 16. Demolition

1.3 DEFINITION OF WORK RESPONSIBILITY

- A. All electrical control components including starters required for operation of HVAC and plumbing equipment whether integral or remote shall be furnished and installed under this Contract. Control wiring, conduits and accessories for control devices shall be furnished and installed by the Contractor who provides the HVAC and plumbing equipment.
- B. Power wiring from panelboard or similar source through all equipment disconnects to motors or heating equipment shall be furnished and installed by the Electrical Contractor.
- C. Equipment disconnect switches, unless otherwise specified or supplied by the equipment supplier as an integral part of the equipment shall be furnished and installed by the Electrical Contractor.
- D. All electrical equipment, components, and wiring furnished and installed under this portion of the specifications shall conform to all requirements of the applicable portions of the electrical specifications.

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- E. All base flashing, where required, shall be by others, with necessary counter-flashing by this contractor.
- F. All structural work needed for support of mechanical equipment or components shall be supplied by this contractor.
- G. All concrete pads necessary for the support of HVAC and plumbing equipment or components shall be supplied by the contractor who provides the HVAC and plumbing equipment.
- H. All access panels in finished walls or ceilings shall be supplied by this contractor for installation by the General Contractor.
- I. If any changes are required in the installation of mechanical or electrical services to any mechanical equipment accepted as approved equals, the Mechanical Contractor shall be responsible for any additional costs incurred or coordination required.

1.4 RULES AND REGULATIONS

- A. All work shall be performed in accordance with the rules and regulations of the National Plumbing Code, local plumbing codes, the utilities having jurisdiction, and the IPC 2006, IBC 2006, IMC 2006, NFPA Code, Uniform Plumbing Code (1991).
- B. All work shall be performed in accordance with the rules and regulations of Pennsylvania Department of Labor and Industry, Federal Department of Labor (Occupational Safety and Health Administration), the Department of Education, and all codes and agencies having jurisdiction.
- C. All construction, design fabrication, tests, rating and installation shall comply with the rules and regulations of all local, state or national codes and agencies having jurisdiction over this project. Any costs involved in complying to these rules and regulations shall be included in original bid of this Contractor.
- D. This Contractor shall obtain and pay for all construction and installation permits, certificates and inspection fees relative to his work. He shall also prepare all specific plans as required by proper authorities before acceptance of the work. Costs incurred in the preparation of such plans shall be included in the Contractor's original bid.

1.5 DRAWINGS

- A. The accompanying drawings are a part of these specifications and are intended to show approximate and relative locations of services and equipment. They shall not be scaled to determine exact positions, locations and clearances.
- B. Due to the diagrammatic layout and small scale of the drawings, certain piping and duct rises, drops, offsets, valves, and related specialties are not shown. The Contractor shall provide all ductwork, piping, fittings, valves, and specialties required to insure a complete installation without additional cost to the Owner.
- C. All drawings and specifications pertaining to general construction, plumbing, HVAC, electrical and other work shall be carefully examined. Where physical interferences with his work occur because of his failure to consult other trades, this Contractor shall rearrange his work at his own expense.

1.6 SUBMISSION OF SHOP DRAWINGS, EQUIPMENT, AND MATERIALS

- A. The Contractor shall submit, with a letter of transmittal to the Architect, the quantity of sets of shop drawings specified in Division 1 containing all capacities, performances, features, options, accessories and technical data of all materials and equipment listed herein. All submittals shall be made within 45 days after awarding of the contract.
- B. Refer to Section 010300.
- C. All disapproved submittals shall be corrected as directed by the Architect and resubmitted in 6 sets until approved within 30 days after the original submittal was disapproved. No work involving any materials or equipment covered by shop drawings shall be started until the respective shop drawings are approved.
- D. None of the items listed under Section 1.2 shall be installed until final approval has been given by the Architect.
- E. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number and specification section number, as appropriate on shop drawings.
- F. On shop drawings, apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the Work and Contractor Documents.
- G. On shop drawings, provide space for Contractor and Architect/Engineer and Construction Manager review stamps.

1.7 VISIT TO THE SITE

- A. Prior to submission of his bid, the Contractor shall visit the site to acquaint himself with the existing conditions. Bids as submitted will be interpreted to include all costs and change made necessary by such conditions.

1.8 COORDINATION OF WORK

- A. Contractor shall coordinate his work with that of other trades. In case of interference or problems the Architect shall decide which work is to be relocated, regardless of which is installed first.

1.9 LOCATION OF EQUIPMENT

- A. All locations of plumbing, HVAC and fire protection equipment and pipe connections thereto shall be verified by the Owner and Architect. The contractor shall verify locations sufficiently in advance of the installation to allow uninterrupted progress of the work of all trades.
- B. When so directed by the Architect, the Contractor shall prepare dimensioned arrangement drawings at a scale of (1/4" = 1'0"). Layouts represented by these drawings shall be coordinated with all other trades.
- C. This contractor shall obtain approval of all arrangement drawings before continuing his work.

1.10 MATERIALS AND EQUIPMENT

- A. All materials and equipment, unless otherwise specified, shall be new and of the best quality, approved for their specific application.
- B. This Contractor shall provide, when required by the Architect, labeled samples of materials to be used on the project. Samples shall be submitted for approval by the Architect prior to their installation.
- C. All materials and equipment installed by the Contractor shall be securely and rigidly supported from or attached to the building structure.

1.11 WORKMANSHIP

- A. All workmanship shall be done according to the best practices of the trade by qualified and competent tradesmen.

1.12 PROTECTION OF EQUIPMENT

- A. The Contractor shall protect all material and equipment from damage until final acceptance as installed. He shall close all openings during construction with temporary plugs and replace all damaged items with ones of exact sameness at his expense.
- B. He shall schedule material and systems for delivery in such a pattern that critical pieces of equipment may be stored within the building, protected from weather. Where materials are stored outside, they must be protected from the elements and damage.
- C. This Contractor shall be responsible for coordinating the procurement of specified materials and equipment being supplied by his sub-contractors and suppliers.

1.13 SCAFFOLDING AND HOISTING

- A. The Contractor shall furnish and erect all scaffolding, hoists, shoring, platforms, railings, ladders, and other devices required by local, state, and federal laws to install his systems and equipment. Scaffolding and all other equipment shall be removed at completion of the work.
- B. Contractor shall hoist or rig his own material and equipment into place, or arrange for the rigging of it by others at his expense.

1.14 FOREMAN

- A. Contractor must provide a competent foreman, subject to approval of the Architect. The foreman shall be deemed the agent of the Contractor and must be on duty at the building during all working hours.
- B. Any instructions or notices given to the foreman shall have the same force as if given to the Contractor in person.

1.15 EXCAVATION AND BACKFILL

- A. The Contractor shall do all excavation and backfilling and all shoring, sheeting, pumping, and other work incidental to excavating as required for his installation.

- B. Backfill shall be made with clear earth; free from rocks, frozen earth, debris, or other foreign materials. Backfill shall be deposited in uniform layers of not over 8" thick and each layer shall be mechanically tamped before the next layer is applied.
- C. All excavated material remaining after the backfilling operation shall be removed from the site by this Contractor.
- D. Any settlement in trench backfill shall be brought to grade, and damage to pavement or slabs caused by such settlement shall be repaired at the Contractor's expense.
- E. All ditching, pumping, canvas covers, and other methods required to protect and keep all excavation and trenches free from water at all times during the construction period shall be furnished, installed, and maintained by the Contractor. If the trench bottom becomes muddy, all mud shall be removed and replaced by bankrun sand and gravel or other suitable material as approved by Architect, and compacted to the density of the surrounding undisturbed soil. Bottom of trench shall be protected against frost or freezing. This Contractor shall provide adequate shoring to protect his and other workmen. Shoring shall be maintained until tests of lines are completed.
- F. Trenches that pass under paving or roads and have less than 2' of cover, shall have a load-relieving slab over the pipe. Trenches which pass under or within 18" of any wall foundation shall be backfilled with concrete mixes 1 part cement, 3 parts sand, and 5 parts coarse aggregate.
- G. All repair of macadam or concrete paving made necessary by work done under this contract shall be performed by General Contractor at the expense of this contractor. All such repairs shall match surrounding paving in materials and workmanship.
- H. All grading and seeding made necessary by work done under this contract shall be performed by the General Contractor at the expense of this contractor. Work shall comply with the Architectural Section of the Specifications.

1.16 PAINTING

- A. All exposed piping, iron work, and equipment installed in the mechanical equipment rooms under this contract shall be painted 1 prime coat and 2 coats of best quality oil paint of color as selected by the Architect.
- B. Unless specifically noted, insulation and galvanized piping in ceiling cavity area shall not be painted.
- C. All grilles, louvers, etc. unless otherwise indicated shall be either furnished in or painted in a color selected by the Architect. When requested by the Architect, the equipment shall be finished with a prime coat and then professionally painted in the field in a color selected by the Owner. The Mechanical Contractor shall assume responsibility for all costs involved.

1.17 CUTTING AND PATCHING

- A. This Contractor shall be responsible for all cutting and patching required for installation of his work on this project. Cutting and patching methods shall conform to the requirements for new construction contained in other sections of this specification
 - 1. Patching in surfaces that will remain visible when the project is finished shall be identical in appearance to the undisturbed surface.

2. Patches in fire rated walls, ceilings and floors shall maintain the fire rating of these barriers by the use of approved materials including special fire rated sealing compounds or materials identical to the barrier materials. Refer to the Architectural Specifications for approved methods and materials.

1.18 WORK SEQUENCE

- A. Refer to Architectural Drawings and Specifications for Phasing Requirements for this Project. This Contractor shall plan and coordinate his work in accordance with those requirements.

1.19 CLEANING

- A. Upon completion of the installation, thoroughly purge all piping of all obstructions and scale and adequately flush all liquid carrying piping to assure a clean system.
- B. Wash all fixtures with soap and water, remove labels and protective covering and clean all grease and cutting from plates or polished piping and trim.
- C. Where damage to finish, furnishing or parts of the building results from pipe stoppage or from failure to clear and flush piping systems properly, the Contractor shall, at his own expense, employ qualified skilled labor to make repairs.

1.20 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. The Contractor shall prepare for the Owner, 3 hard bound volumes, each containing all operating instructions and information necessary for the care and maintenance of the system. These volumes shall be complete in every respect, and shall include detailed operating instructions for each piece of equipment and diagrams for control wiring and piping so arranged and detailed that the maintenance staff may trace the control in event of operational malfunctioning.
- B. The Contractor shall submit 1 of the hard bound volumes to the Architect for approval prior to presenting same to Owner.
- C. Printed instructions covering the operation and maintenance of each item of equipment shall be posted at locations designated by the Architect.
- D. The Contractor shall provide Project Records Documents in accordance with requirements of Division 1.

1.21 CLEANING AND FINISHING

- A. After all tests have been made and the system proven satisfactory to the Architect, the Contractor shall go over the entire project, clean all equipment and material installed by him, and leave in a clean and working condition.

1.22 INSTRUCTION OF EMPLOYEES

- A. At the completion of the work this Contractor shall instruct the employees who shall have charge of the equipment in the care, adjustment, and operation of all parts of the system.

- B. At the time designated by the Architect, the equipment manufacturer's engineer shall instruct representatives of the Owner in the operation and maintenance of the equipment.

1.23 GUARANTEE

- A. All work done under these contracts shall be guaranteed by the respective contractors against defective materials and faulty workmanship for a period of 1 year from date of acceptance by the Owner.
- B. During such a period, and before the expiration of each such guarantee, contractor shall agree to make any and all repairs, adjustments, or replacements which may become necessary, owing to initial settlement or shrinkage, defective material, workmanship, or installation.
- C. He shall further agree to provide all labor and material which may be required and to restore to its original condition any adjacent work that he may disturb in making the necessary repairs, adjustments, or replacements in order to fulfill this guarantee.

1.24 GENERAL NOTE

- A. The HVAC Contractor shall replace filters in all new gas furnaces at the completion of the project.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment to permit removal of components and parts which require periodic replacement or maintenance. Arrange pipes, ducts, and equipment to permit access to valves, gauges, starters, motors, doors and access panels.
- B. Provide access panels in equipment, ducts, etc. as required for inspection and maintenance.

3.2 PIPING INSTALLATION

- A. In general, piping shall be exposed in equipment rooms, and concealed in all finished rooms. Where piping is exposed, it shall be run so as to allow maximum headroom consistent with proper pitch. No piping or ductwork shall cross below the head of any window or door.
- B. Exposed piping, ducts, conduits, and/or appurtenances indicated on the inside of buildings, shall be installed parallel to the building lines. All piping shall be kept as close as possible to the ceilings and walls, and columns, to take up the minimum amount of space.
- C. All work shall be arranged and installed as high as possible to prevent obstruction of window areas, and to give adequate clearance and access for operation and maintenance.

3.3 SLEEVES

- A. Where pipes pass through concrete or masonry walls or concrete floors, they shall be protected through the full depth of the construction with galvanized sleeves; same to be at least one size larger than the pipe plus insulation.
- B. Where sleeves occur in concrete floors, the top of sleeve shall be flush with finished floor line, and the end shall be filed to a smooth round finish.
- C. This Contractor shall supply all pipe sleeves and shall inform general contractor of exact sleeve locations in time for their incorporation onto the concrete forms or masonry work.
- D. Any cutting and patching in masonry or concrete made necessary by failure to adequately coordinate with the general contractor shall be done by the Masonry or Pre-Cast Contractor at the expense of this contractor.
- E. The space between pipes and sleeves shall be caulked air tight with a non-combustible inorganic material.

3.4 UNIONS

- A. Unions shall be provided at all connections to each piece of equipment and on both sides of all automatic valves, and devices which requires removal for maintenance. No unions are to be placed in a location which will be inaccessible after the completion of the project.
- B. Unions of copper tubing shall be 200 lbs. SWP brass ground joint.
- C. Unions for steel pipe shall be 250 lbs. SWP, malleable iron with brass to iron seat.

3.5 CLEARANCE

- A. All piping, including valves and fittings shall be installed to provide the following minimum clearances between the finish coverings, adjacent pipe and/or conduits: 2" between for piping services and 6" between piping services and electrical conduits.

3.6 INCREASES AT ROOF

- A. All soil, vent and waste stacks shall be increased to a minimum of 3" in size immediately before such pipes extend through the roof. All stacks extending through the roof shall finish at least 2' above the roof level.

3.7 SHOCK ABSORBERS

- A. Furnish and install absorbers where shown on the drawings and where required for proper system operation.

3.8 ESCUTCHEON PLATES

- A. All piping passing through walls, ceilings, and floors shall be provided with escutcheon plates securely fastened in place. Where installed on piping in finished areas they shall be chrome plated.

3.9 ACCESS PANELS

- A. Removable panels shall be located so as to provide easy access to all concealed plumbing accessories that may require adjustments or maintenance, such as valves, water hammer arresters, traps, strainers, cleanouts or others.
- B. Access panels in finished wall or ceiling surfaces shall be furnished by this Contractor for installation by the General Contractor.
- C. This Contractor shall pay for any work made necessary by his failure to inform other trades of access panel locations.

3.10 APPLICATIONS OF INSULATION AND COVERING

- A. No covering shall be installed by the Contractor until the piping and ducts have been approved by the Architect/ Engineer.

3.11 PIPING UNDER FLOORS

- A. Wherever piping, conduits and associated materials is run under a floor slab on grade, the work is to be installed after the sub-grade has been brought to the proper level. The work shall then be installed and backfilled, allowed to settle, and refilled before placing crushed stone fill.

3.12 INSERTS

- A. Except as noted, provide box type inserts for all hangers and supports intended to suspend piping or light weight equipment from new concrete construction. Fasten all inserts to the form work before concrete is poured. Inserts to be Grinnell Figure No. 282 or Figure No. 279 depending upon the maximum load to be carried.
- B. No toggle bolts, expansion screw anchors or similar imbedded hanger supports shall be used in new construction.

3.13 CHASES AND OPENINGS IN FLOORS AND WALLS

- A. It shall be the duty of the Contractor requiring chases, openings or the placement of any sleeves, anchors, and supports required for his work, whether or not shown on the drawings, to advise the General Contractor accordingly, prior to or at the time of pouring concrete slabs, beams or the building of walls, etc. He shall furnish all such sleeves, anchors, and supports in place, and all necessary information for the proper location of said chases or openings.
- B. If a contractor shall fail to observe and comply with those requirements, he shall cut, at his own expense, after receiving the consent of the Architect, such chases or openings as may be necessary and proper, providing and building in place all lintels required by these openings, doing the necessary patching and rebuilding of the work required under the direction of the respective contractors and he shall be responsible for all loss or delay resulting therefrom.

3.14 LUBRICATION

- A. The contractor shall provide all oil for the operation of all equipment until acceptance. The Contractor shall run in all bearings and, after they are run in, drain all oil from the bearings, flush out all bearings, and refill with

new oil. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated by him up to the date of acceptance of the equipment. The contractor shall be required to protect all bearings during installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction.

3.15 JOINTS AND CONNECTIONS

- A. Screwed Connections - All joints made in screwed pipe shall be made with red lead or pipe compound applied to the threaded end of the pipe and not applied within the fitting. Threads shall be cut straight and true with sections reamed and cleaned before installation.

END OF SECTION 230010

SECTION 230100

MECHANICAL GENERAL EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Equipment Hangers and Supports
- B. Equipment Bases and Supports
- C. Sleeves and Seals
- D. Flashing and Sealing Equipment and Pipe Stacks
- E. Single Phase Electric Motors
- F. Three Phase Electric Motors
- G. Nameplates
- H. Tags
- I. Stencils
- J. Pipe Markers
- K. Vibration Isolation

1.2 REFERENCES

- A. ASME - B40.1 - Gages - Pressure Indicating Dial Type - Elastic Element.
- B. ASTM E1 - Specification for ASTM Thermometers.
- C. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.
- D. UL 393 - Indicating Pressure Gages for Fire and Protection Services.
- E. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- F. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- G. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- H. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- I. NFPA 13 - Installation of Sprinkler Systems.
- J. NFPA 14 - Installation of Standpipe and Hose Systems
- K. NEMA MG 1 - Motors and Generators.
- L. NFPA 70 - National Electrical Code.

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13-0303.00 Lebanon Ridge Oral Health

M. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 PERFORMANCE REQUIREMENTS FOR PIPING EXPANSION COMPENSATION

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

B. Expansion Calculations:

1. Installation Temperature: 50°F.
2. Hot Water Heating: 210°F.
3. Domestic Hot Water: 140°F.
4. Safety Factor: 30%

1.4 SUBMITTALS

A. Submit in accordance with provisions of Section 230010.

B. Product Data:

1. Gages and Meters: Provide list which indicates use, operating range, total range and location for manufactured components.
2. Supports and Anchors: Provide manufacturers catalog data including load capacity.
3. Motors: Provide wiring diagrams with electrical characteristics and connection requirements.
4. Mechanical Identification: Provide manufacturers catalog literature for each product required.
5. Vibration Isolation: Provide schedule of vibration isolator type with location and load on each.

C. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable electrical code.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Grinnell
2. Other acceptable manufacturers offering equivalent products.
 - a. or approved equal

B. Plumbing Piping - DWV:

1. Conform to ASTM F708, MSS SP58, MSS SP69, MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2": Malleable iron adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2" and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3": Cast iron hook.

6. Wall Support for Pipe Sizes 4" and Over: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Plumbing Piping - Water, Medical Gas, Vacuum
1. Conform to ASTM F708, MSS SP58, MSS SP69, MSS SP89.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2": Malleable iron adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2" and Over: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 2 to 4": Carbon steel, adjustable, clevis.
 5. Hangers for Hot Pipe Sizes 6" and Over: Adjustable steel yoke, cast iron roll, double hanger.
 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6" and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
 8. Wall Support for Pipe Sizes to 3": Cast iron hook.
 9. Wall Support for Pipe Sizes 4" and Over: Welded steel bracket and wrought steel clamp.
 10. Wall Support for Hot Pipe Sizes 6" and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
 11. Vertical Support: Steel riser clamp.
 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes to 4": Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 14. Floor Support for Hot Pipe Sizes 6" and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 PIPE HANGER ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS

- A. Manufacturers:
1. Grinnell.
 2. Other acceptable manufacturers offering equivalent products.
 - a. or approved equal
- B. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

- A. Metal Flashing: 26 ga galvanized steel.
- B. Metal Counterflashing: 22 ga galvanized steel.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22 ga minimum; 16 ga at fire resistant elements.

2.5 EQUIPMENT CURBS

- A. Fabrication: Welded 18 ga galvanized steel shell and base, mitered 3" cant, 12" thick insulation, factory installed wood nailer.

2.6 SLEEVES AND SEALANTS

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 ga galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.
- E. Firestopping Insulation: Glass fiber type, non-combustible.
- F. Sealant: Acrylic.

2.7 MOTORS

- A. Manufacturers:
 - 1. Century
 - 2. Westinghouse
 - 3. Lincoln
 - 4. Baldor
 - 5. Or approved equal
- B. General Construction and Requirements
 - 1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.
 - 2. Electrical Service:
 - a. Refer to Section 16180 for required electrical characteristics.
 - 3. Type:
 - a. Open drip-proof except where specifically noted otherwise.
 - b. Motors: Design for continuous operation in 40°C environment.
 - c. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - d. All motors shall be high efficiency type.
 - 4. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
 - 5. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
 - 6. Wiring Terminations:
 - a. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - b. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.8 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2" diameter.
- B. Chart: Typewritten letter size list in anodized aluminum frame. Room numbers shall correspond to Owners room numbering system.

2.9 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4" Outside Diameter of Insulation or Pipe: 8" long color field, 1/2" high letters.
 - 2. 1-1/2" to 2" Outside Diameter of Insulation or Pipe: 8" long color field, 3/4" high letters.
 - 3. 2-1/2" to 6" Outside Diameter of Insulation or Pipe: 12" long color field, 1-1/4" high letters.
 - 4. 8 to 10" Outside Diameter of Insulation or Pipe: 24" long color field, 2-1/2" high letters.
 - 5. Over 10" Outside Diameter of Insulation or Pipe: 32" long color field, 3-1/2" high letters.
 - 6. Ductwork and Equipment: 2-1/2" high letters.
- B. Stencil Paint: As specified in Section 09900, semi- gloss enamel, colors conforming to ASME A13.1.

2.10 PIPE MARKERS

- A. Color: Conform to ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6" wide by 4 mil thick, manufactured for direct burial service.

2.11 VIBRATION ISOLATORS

- A. Neoprene Pad Isolators:
 - 1. Rubber or neoprene waffle pads.
 - a. 30 durometer.
 - b. Minimum 1/2" thick
 - c. Maximum loading 40 psi
 - d. Height of ribs shall not exceed 0.7 times width
 - 2. Configuration: Single layer
- B. Rubber Mount or Hanger: Molded rubber designed for 0.5" deflection with threaded insert.
- C. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mechanical Identification:
 - 1. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
 - 2. Install tags with corrosion resistant chain.
 - 3. Apply stencil painting in accordance with Section 09900.

4. Install plastic pipe markers in accordance with manufacturer's instructions.
5. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
6. Install underground plastic pipe markers 6 to 8" below finished grade, directly above buried pipe.
7. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with stencil painting. Small devices, such as in-line pumps, may be identified with tags.
8. Identify control panels and major control components outside panels with plastic nameplates.
9. Identify thermostats relating to terminal boxes or valves with nameplates.
10. Identify valves in main and branch piping with tags.
11. Identify air terminal units and radiator valves with numbered tags.
12. Tag automatic controls, instruments and relays. Key to control schematic.
13. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4" diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20' on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
14. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
15. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
16. Provide Valve Identification Chart. Post framed chart in Boiler Room.

B. Vibration

1. Install isolation for motor driven equipment.
2. Bases:
 - a. Set steel bases for 1" clearance between housekeeping pad and base.
 - b. Set concrete inertia bases for 2" clearance between housekeeping pad and base.
 - c. Adjust equipment level.
3. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
4. Connect wiring to isolated equipment with flexible hanging loop.
5. All vibration isolation devices, including steel bases and pouring forms, shall be supplied by a single manufacturer.
6. All piping located in Boiler Room shall be isolated from the building structure by means of spring hangers.
7. For Air Handlers not located in the Mechanical Rooms, all piping 1" in diameter or greater shall be isolated with spring hangers having the same deflection, for the first three hangers, as those for the machine to which it is connected.
8. Bases for all end suction pumps shall be sized to include supports for the suction and discharge elbows.
9. Flexible conduit shall be used for all electrical connections to isolated equipment. Flexible conduit shall be 50% longer than the actual distance between the rigid conduit and the equipment electrical connection locations.
10. The schedule of isolators required shall be as follows: Chiller - 1/4" deflection neoprene or fiberglass pads; Pumps - inertia bases, 1" (minimum) deflection springs; Air handling units in mechanical rooms on grade - 1/4" deflection neoprene or fiberglass pads; Ceiling mounted air handling units - 1" deflection springs; piping - all piping in the mechanical rooms should have isolation hangers having the same deflection as those for the equipment in the rooms, or for 50' from the equipment, whichever is greater. For the ceiling mounted air handling units, any

- piping larger than 1" diameter should have the first three hangers of the same deflection as the equipment (1").
11. Spring hangers for piping shall consist of clevis type hangers with spring hanger similar to Grinnell Fig. 247 or Fig. B-268 installed in threaded rod.
- C. Motors:
1. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
 2. Check line voltage and phase and ensure agreement with nameplate.
- D. Inserts:
1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4".
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Pipe Hangers and Supports:
1. Support horizontal piping as scheduled.
 2. Install hangers to provide minimum 1/2" space between finished covering and adjacent work.
 3. Place hangers within 12" of each horizontal elbow.
 4. Use hangers with 1-1/2" minimum vertical adjustment.
 5. Support horizontal cast iron pipe adjacent to each hub, with 5' maximum spacing between hangers.
 6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 8. Support riser piping independently of connected horizontal piping.
 9. Provide copper plated hangers and supports for copper piping.
 10. Design hangers for pipe movement without disengagement of supported pipe.
 11. Provide additional supports for heavy valves and specialties and provide sway bracing where needed.
 12. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 13. Insulation protection saddles shall be installed at all pipe hangers and supports for insulated lines. Saddles shall be rolled with a radius to suit the insulation O.D. Saddles shall be #16 gauge galvanized steel and shall be 8" long.
- F. Equipment Bases and Supports:
1. Provide housekeeping pads of concrete, minimum 4" thick and extending 4" beyond supported equipment.
 2. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
 3. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
 4. Provide rigid anchors for pipes after vibration isolation components are installed.
- G. Flashing:
1. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
 2. Flash vent and soil pipes projecting 3" minimum above finished roof surface with lead worked 1" minimum into hub, 8" minimum clear on sides

- with 24 x 24" sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.
3. Flash floor drains in floors with topping over finished areas with lead, 10" clear on sides with minimum 36 x 36" sheet size. Fasten flashing to drain clamp device.
 4. Seal floor, shower and mop sink drains watertight to adjacent materials.
 5. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
 6. Provide curbs for mechanical roof installations 12" minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
 7. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

H. Sleeves:

1. Set sleeves in position in formwork. Provide reinforcing around sleeves.
2. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
3. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.
4. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
5. Install chrome plated steel escutcheons at finished surfaces.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 230010.

3.3 SCHEDULES

A. Pressure Gage Schedule

1. LOCATION: Water Heater Outlet

B. Stem Type Thermometer Schedule

1. LOCATION: Water Heater Outlet

C. Supports and Hangers

PIPE SIZE	MAX. HANGER SPACING	HANGER ROD
Inches	Feet	DIAMETER
2 to 1	6	3/8
1-1/4 to 2	9	3/8
2-1/2 to 3	10	1/2
4 to 5	12	5/8
6	12	3/4
8 to 12	12	7/8
14 and Over	12	1
PVC (All Sizes)	4	3/8
C.I. Bell and Spigot (or No-Hub) and at Joints	5	3/4

3.4 APPLICATION

- A. Motors:

1. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
2. Single phase motors for fans, pumps, blowers, air compressors: Capacitor start type.
3. Motors located in exterior locations: Totally enclosed type.
4. Motors located in outdoors: Totally enclosed weatherproof epoxy-treated type.
5. Motors located in outdoors: Totally enclosed weatherproof epoxy-sealed type.

END OF SECTION 230100

SECTION 230250

INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation
- B. Jackets and Accessories
- C. Equipment Insulation
- D. Covering
- E. Breeching Insulation
- F. Ductwork Insulation
- G. Duct Liner
- H. Insulation Jackets

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
- B. National Fire Protection Association (NFPA)
- C. Underwriters Laboratories (UL)
- D. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
- E. ASHRAE Standard 90A-1980

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.

1.4 QUALITY ASSURANCE

- A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, UL 723.

PART 2 - PRODUCTS

2.1 PIPING INSULATION

- A. Manufacturers

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1. Owens-Corning
2. Johns Manville
3. Certainteed
4. Armstrong
5. PPG
6. Knauf

2.2 DOMESTIC WATER PIPING INSULATION

- A. All domestic hot and cold water pipes, fittings, flanges, and valves shall be insulated with nominal 1/2" wall thickness (cold water) or 1" wall thickness (hot water) heavy density fiberglass insulation similar to Owens/Corning Fiberglass 24ASJ/SSL pipe insulation or equal with all service jacket, self-sealing lap and UL listed. Insulation shall have flame spread rating of 25 or less when tested by ASTM E-84 method. Hot water piping over 2" size shall be insulated with 1-1/2" thick insulation.
- B. Optional pipe insulation shall be Armaflex insulation. (Concealed Areas Only)

2.3 CONDENSATE DRAINAGE PIPING

- A. All above ground condensate pipes and fittings shall be insulated with nominal 1/2" wall thickness heavy density fiberglass insulation similar to Owens/Corning Fiberglass 24ASJ/SSL pipe insulation or equal with all service jacket, self-sealing lap and UL listed. Insulation shall have flame spread rating of 25 or less when tested by ASTM E-84 method.
- B. Optional pipe insulation shall be 1/2" thick Armaflex insulation. (Concealed Areas Only)

2.4 DUCT INSULATION

- A. Provide and install acoustic and thermal lining in all supply air, fresh air, and return air ductwork except where noted.
- B. Lining shall be 1" thick fiberglass semi-rigid board type, or duct liner, 3.0 lbs. per cubic foot density, with a thermal conductivity of approximately 0.23 BTUH/hr. - sq. ft. - °F. - inch.
- C. Relief ducts, exhaust ducts and transfer ducts shall not be lined.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that piping, equipment, materials, have been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. On exposed piping, locate insulation and cover seams in least visible locations.

- C. Insulated pipes and equipment conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory applied or field applied.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
 - 3. PVC fitting covers shall be used.
 - 4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
 - 5. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- D. For insulated pipes and equipment conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with vapor barrier, factory applied or field applied.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 - 3. PVC fitting covers shall be used.
- E. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- F. Cover hydrous calcium silicate insulation or Fiberglass Industrial Insulation Board with metal mesh and finish with heavy coat of insulating cement.
- G. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
- H. Install insulation for equipment requiring access for maintenance, repair, or cleaning, in such a manner that it can be easily removed and replaced without damage.
- I. For exterior applications, provide insulation with vapor barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
- J. All ductwork on roof shall be lined as specified and also externally insulated with 2" fibrous board duct insulation. Insulation shall be glued and mechanically fastened to ductwork and sealed at joints with vapor barrier tape. Insulation shall be weatherproofed with EDPM covering.
- K. External Duct Insulation Application:
 - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure insulation without vapor barrier with staples, tape or wires.
 - 3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
 - 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- L. Insulation including finishes and adhesive on the exterior surfaces of ducts and equipment shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as determined by an independent testing laboratory in accordance with NFPA 255-1972 as required by NFPA 90A. Smoke development rating for pipe insulation shall not exceed 50.
- M. Linings in air ducts and equipment shall meet the Erosion Test Method described in Underwriter's Laboratories Publication No. 181. These linings, including coatings and adhesives and insulation on exterior surfaces of pipes and ducts

in building spaces used as air supply plenums, shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as determined by an independent testing laboratory in accordance with NFPA 255-1972 as required by NFPA 90A.

N. Duct Insulation

1. All insulation surfaces shall be coated with a compound to prevent erosion, flaking or peeling of liner material at air velocities of 2000 ft./minute.
2. Insulation shall be applied using UL approved fire retardant adhesive and mechanical fasteners. Adhesive shall be water based Foster 85-17 or approved equal. Mechanical fasteners shall be Gripnail Corporation, or equal with self-locking washers, and shall be spaced not more than 6" apart on leading edges of liner.
3. Top sheets of insulation in rectangular ducts shall lap the side sheets.
4. All joints and seams in the lining shall be painted to a smooth surface with a fire retardant insulation sealer, Foster 30-70 or equal as approved.
5. All duct liner shall be anti-microbial.

END OF SECTION 230250

SECTION 230300

FIRE PROTECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe & Fittings
- B. Valves
- C. Fire Department Connections
- D. Wet-Pipe Sprinkler System
- E. System Design, Installation, Certification

1.2 SCOPE

- A. Provide and install a complete and operating sprinkler system in accordance with these specifications and accompanying contract drawings. This shall include all required labor, materials, equipment, supervision and testing.
- B. The work includes the following systems, equipment, materials, and labor but is not necessarily limited by this summary.
 - 1. A complete wet type sprinkler system including all sprinkler heads, piping, and special valves. Protect all areas shown fully as required. System shall be designed for Light Hazard, and shall be hydraulically designed to provide 0.10 gpm per square foot over the most hydraulically remote 1,500 square foot area. System for areas such as Storage Rooms, Mechanical Rooms, etc. shall be designed for Ordinary Hazard, Group 1, and shall be hydraulically designed to provide 0.16 gpm per square feet over the most hydraulically remote 1,500 square foot area.
 - 2. All alarm and detecting devices. Provide tamper switches for all valves per NFPA #13.
 - 3. Inspectors test connections as required
 - 4. Connection to the water main
 - 5. Drains as required
 - 6. Fire Department connection
 - 7. Water Motor Gong

1.3 ELECTRICAL WIRING

- A. Electrical wiring shall be furnished and installed as part of this contract as described below.
- B. A full complement of electrical required for intended use and/or operation of specified equipment whether integral or remote, shall be furnished under this portion of specifications. Power wiring (Where required) through these devices shall be installed under Electrical portion of specifications. Control wiring, conduit and accessories for these devices (flow switches, tamper switches, etc.) shall be furnished and installed under this portion of specifications. Connect to local Normal/Emergency Electric Panel on Emergency circuit. Responsibility for proper functioning of equipment shall be under this portion of specifications. Where components are installed in locations exposed to weather, they shall be weatherproofed.

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- C. Wiring for tamper switches, flow switches will be by EC.

1.4 REFERENCES

- A. ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
- B. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.
- C. ANSI/ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings.
- D. ANSI/ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded.
- E. ANSI/ASME B16.25 - Buttwelding Ends.
- F. ANSI/ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
- G. ANSI/ASTM A135 - Electric-Resistance-Welded Steel Pipe.
- H. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings.
- I. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast.
- J. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
- K. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- L. NFPA 13 - Installation of Sprinkler Systems.
- M. NFPA 14 B Stand Pipe Systems
- N. NFPA 20 - Fire Pump Systems

1.5 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- C. Shop Drawings: Indicate hydraulic calculations, detailed pipe layout, hangers and supports, components and accessories. Indicate system controls.
- D. Product Data: Provide data on sprinkler heads, valves, and specialties, including manufacturers catalogue information. Submit performance ratings rough-in details, weights, support requirements, and piping connections.
- E. Submit shop drawings, product data and hydraulic calculations to authority having jurisdiction, Fire Marshall and Owner's insurance underwriter for approval. Submit proof of approval to Architect/Engineer. Obtain approval prior to start of any work.

1.6 QUALITY ASSURANCE

- A. Sprinkler Systems: Perform work to NFPA 13, Fire Marshall, Local Authority, UL.
- B. Welding Materials and Procedures: Perform to ASME Code.

- C. Valves: Bear UL or FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.

1.7 EXTRA MATERIALS

- A. Provide extra sprinkler heads under provisions of NFPA 13.
- B. Provide suitable wrenches for each head type.
- C. Provide metal storage cabinet in location designated.

PART 2 - PRODUCTS

2.1 SPRINKLER PIPING, BURIED

- A. Cast Iron Pipe: ANSI/AWWA C151, Cement lined ductile iron - Class 52.
 - 1. Fittings: ANSI/AWWA C110, standard thickness.
 - 2. Joints: ANSI/AWWA C111, tyton or mechanical joints.

2.2 SPRINKLER AND STANDPIPE PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53; ANSI/ASME B36.10; Schedule 10 or 40 black (Sprinkler).
 - 1. Steel Fittings: ANSI/ASME B16.9, wrought steel, butt welded; ANSI/ASME B16.25, butt weld ends; ASTM A234, wrought carbon steel and alloy steel; ANSI/ASME B16.5, steel flanges and fittings; ANSI/ASME B16.11, forged steel socket welded and threaded.
 - 2. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.3 GATE VALVES

- A. Manufacturers:
 - 1. Grinnell
 - 2. Nibco
 - 3. Mueller
- B. Up to and including 2": Bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge or disc, threaded ends.
- C. Over 2": Iron body, bronze trim, rising stem, handwheel, OS&Y, solid wedge, flanged or grooved ends.

2.4 GLOBE VALVES

- A. Manufacturers:
 - 1. Grinnell
 - 2. Nibco
 - 3. Mueller
- B. Up to 2": Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable composition disc, screwed ends, with backseating capacity.
- C. Over 2": Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.5 BALL VALVES

- A. Manufacturers:
 - 1. Nibco
 - 2. Approved equal
- B. Up to and including 2": Bronze one piece body, brass ball, Teflon seats and stuffing box ring, lever handle threaded ends with union.

2.6 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Nibco
 - 2. Jamesbury
 - 3. Grinnell
- B. Cast or ductile iron body, chrome plated ductile iron disc, resilient replaceable EPDM seat, lug type, extended neck, handwheel and gear drive and integral indicating device and built-in tamper proof switch rated at 115 volt AC.

2.7 CHECK VALVES

- A. Manufacturers:
 - 1. Nibco
 - 2. Mueller
 - 3. Grinnell
- B. Up to and including 3": Bronze swing disc, screwed ends.
- C. Over 3": Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends or wafer style.

2.8 DRAIN VALVES

- A. Manufacturers:
 - 1. Nibco
 - 2. Crane
 - 3. Stockham
- B. Bronze compression stop with hose thread nipple and cap.
- C. Brass ball valve with cap and chain, 3/4" hose thread.

2.9 SPRINKLER HEADS

- A. Manufacturers:
 - 1. Viking
 - 2. Grinnell
 - 3. Central
- B. Suspended Ceiling:
 - 1. Type: Concealed pendant type with white coverplate.
 - 2. Head Finish: N/A
 - 3. Escutcheon Plate Finish: N/A
 - 4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
 - 5. Wet or dry type as indicated in plans.
 - 6. Quick Response Type

- C. Exposed Area Type:
 - 1. Type: Standard upright type with guard (where indicated).
 - 2. Head Finish: Brass.
 - 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
 - 4. Wet
 - 5. Quick Response Type
- D. Sidewall Type:
 - 1. Type: Standard or Semi-recessed horizontal sidewall type with matching escutcheon plate and guard (where indicated).
 - 2. Head Finish: Chrome plated or enamel in color as selected by Architect.
 - 3. Escutcheon Plate Finish: Chrome plated or enamel in color as selected by Architect.
 - 4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
 - 5. Wet or dry as indicated on the plans.
 - 6. Quick response type.
- E. Extended coverage sprinkler heads may be used if approved by all authorities having jurisdiction.

2.10 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate hydraulically operated alarms, with pressure retard chamber and variable pressure trim, electrical-pressure flow switch, drain, gauges, testing apparatus and accessories.
- B. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy red enameled gong and motor housing, nylon bearings, and inlet strainer.
- C. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts, 115 volt AC.
- D. Fire Department Connection:
 - 1. Type: Bronze finish, Siamese or stortz type as required by local authority.
 - 2. Outlets: Two way Siamese or Stortz type with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
 - 3. Drain: 3/4" automatic drip.
 - 4. Label: "Sprinkler - Fire Department Connection".
- E. Double Detector Check Valve Assembly:
 - 1. Watts No. 709 DDC Series
 - 2. Size: 6", 7.0 psig loss at 1000 GPM
 - 3. Epoxy coated cast iron check valve bodies with bronze seats furnished with bronze body ball valve, test cocks, stainless steel internal parts. Provide strainer and (2) O.S.&Y. Valves, water meter in compliance with local authority.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and foreign material, from inside and outside, before assembly.

- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems and NFPA 14 for standpipe and hose systems.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, and not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- G. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- H. Do not penetrate building structural members unless indicated.
- I. Provide sleeves when penetrating footings, floors and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- J. Die cut screw joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- K. Install valves with stems upright or horizontal, not inverted. Remove protective coatings.
- L. Provide gate, ball or butterfly valves for shut-off or isolating service.
- M. Provide drain valves at main shut-off valves, low points of piping and apparatus.
- N. For underground piping, provide thrust blocks at changes of direction.
- O. Install equipment in accordance with manufacturers instructions.
- P. Install buried shut-off valves in valve box. Provide post indicator.
- Q. Provide double check valve assembly at sprinkler system water source connection.
- R. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent Siamese connectors to allow full swing of fire department wrench handle.
- S. Locate outside alarm gong on building wall as indicated.
- T. Place pipe runs to minimize obstruction to other work.
- U. Place piping in concealed spaces above finished ceilings.

- V. Center heads in ceiling tile.
- W. Flush entire piping system of foreign matter.
- X. Hydrostatically test entire system at 200 psig.
- Y. Require test be witnessed by Fire Marshall and/or authority having jurisdiction.
- Z. A 1" inspector test connection with a 2" smooth bore corrosion resistant outlet shall be installed on the end of the most distant sprinkler line in accordance with NFPA #13. The Inspector's Test Connection shall be equipped with a 1" shut-off valve and plug.
- AA. All valves on connections to water supplies and in supply pipes shall be approved indicating type. Valves shall be supervised open in an approved manner.
- BB. Check valves shall be approved straightway type that can be installed in a vertical or horizontal position.
- CC. Approved automatic ball drip shall be provided in the piping between the check valve and the outside hose coupling.
- DD. All valves shall be protected by tamper switches.

3.3 FLOWTEST

- A. Contractor shall be responsible for conducting water system flow tests to determine system parameters needed for hydraulic design.

END OF SECTION 230300

SECTION 230410

PLUMBING PIPING & SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Valves
- B. Sanitary Sewer Piping System
- C. Domestic Water Piping System
- D. Natural Gas Piping System
- E. Medical Gas Piping System
- F. Medical Vacuum Piping System
- G. Floor Drains
- H. Cleanouts
- I. Hose Bibbs
- J. Hydrants
- K. Backflow Preventers
- L. Water Hammer Arresters

1.2 REFERENCES

- A. ANSI B31.1 - Power Piping.
- B. ASME - Boiler and Pressure Vessel Code.
- C. ASME B16.3 - Malleable Iron Threaded Fittings.
- D. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings.
- E. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings
- F. ASME B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings - DWV.
- G. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- H. ASTM A47 - Ferritic Malleable Iron Castings.
- I. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- J. ASTM A74 - Cast Iron Soil Pipe and Fittings.

- K. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
- L. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- M. ASTM B32 - Solder Metal.
- N. ASTM B88 - Seamless Copper Water Tube.
- O. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- P. ASTM D3033 - Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- Q. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- R. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- S. AWWA C111- Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
- T. AWWA C651 - Disinfecting Water Mains.
- U. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- V. NFPA 54 - National Fuel Gas Code.

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, specialties and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

PART 2 - PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets.
- B. PVC Pipe: ASTM D2729 (if approved by local authority), Schedule 40, solid wall.
 - 1. Fittings: PVC
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.2 SANITARY SEWER PIPING, ABOVE GRADE, DRAIN AND VENT

- A. Cast Iron Pipe: ASTM A74, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: ASTM C564, neoprene gasket system.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

- C. PVC Pipe: ASTM D2729 (if approved by local authority, Schedule 40 Solid Wall)
 - 1. Fittings: PVC
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.3 WATER PIPING, BURIED

- A. Copper Tubing: ASTM B88, Type K, hard drawn.
 - 1. Fittings: ASME B16.18, cast bronze or ASTM B16.22 wrought copper and bronze.
 - 2. Joints: ASTM B32, solder, Grade 95TA.
- B. Cast Iron Pipe: AWWA C151.
 - 1. Fittings: Ductile iron, standard thickness.
 - 2. Joints: AWWA C111, rubber basket with 3/4" (19 mm) diameter rods.

2.4 WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L, hard drawn.
 - 1. Fittings: ASME B16.18, cast bronze, or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, solder, Grade 95TA. (No-Lead)

2.5 BALL VALVES

- A. Manufacturers:
 - 1. Up to and Including 3 Inches:
 - a. Nibco
 - b. Crane
 - c. Stockham
- B. Up to and including 3": Bronze two piece body, bronze ball, Teflon seats and stuffing box ring, lever handle with balancing stops, solder or threaded ends.

2.6 SWING CHECK VALVES

- A. Manufacturers:
 - 1. Nibco
 - 2. Crane
 - 3. Stockham
- B. Bronze swing disc, solder or screwed ends.

2.7 WATER PRESSURE REDUCING VALVES

- A. Manufacturers:
 - 1. Watts
 - 2. Taco
 - 3. Bell & Gossett
- B. Up to 2": Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded and single union ends.
- C. Over 2": Cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.8 RELIEF VALVES

- A. Manufacturers:

1. Watts
2. Bell & Gossett
3. Taco

- B. Bronze body, Teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled, sized for specific application.

2.9 CLEANOUTS

- A. Manufacturers:

1. Zurn
2. Wade
3. Smith
4. Ancon

- B. Exterior Surfaced Areas: Round heavy-duty dura-coated cast iron body with gas and water tight ABS tapered thread plug and round scoriated cover and frame, cast nickel bronze access frame and non-skid cover.

- C. Interior Finished Floor: Dura-Coated cast iron, 2-piece body with double drainage flange, weep holes, and adjustable nickel-bronze strainer, round with scoriated cover, with gas and water tight ABS tapered thread plug.

- D. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

- E. Interior Unfinished Accessible Areas: Threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.10 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53 or A120, Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.
2. Joints: NFPA 54, threaded or welded to ANSI B31.1 ASME Sec 1.

2.11 WALL HYDRANT (P-7)

- A. Wall hydrant shall be Zurn #1300 encased non-freeze type with 3/4" solder inlet, bronze casing, nickel-bronze face, brass operating parts, renewable nylon seat, vacuum breaker and operating key lock.

2.12 FLOOR DRAIN (P-9)

- A. Furnish and install floor drain model Z415 as manufactured by Zurn. Unit shall have durable cast iron body, nickel bronze adjustable strainer and inside caulk outlet. Contractor shall install with deep seal trap and Proset Trap Seal.

2.13 FLOOR DRAIN (P-10)

- A. Furnish and install floor drain, Zurn Model Z-525. Unit shall be 10" diameter medium duty, with durable cast iron body with bottom outlet. It6 shall provide vertical adjustment and be equipped with anti-tilt slotted grate and seepage pan. Contractor shall install with deep seal trap and ProSet Trap Seal.

2.14 BACKFLOW PREVENTER

- A. Backflow Preventer shall be Watts Regulator Series 909 or equal with strainer.
- B. Approved equal.

2.15 WATER HAMMER ARRESTER

- A. Water hammer arresters shall be the Hydra-Rester as manufactured by Sioux Chief Manufacturing Company or equal. Arresters shall be of the piston type with a seamless, Type L Copper chamber and have a permanent PSI air change above a two O-ring piston. Units shall be certified and sized by PDI-WH201 and ASSE-1010 and carry an unconditional lifetime of the system warranty. Arresters shall be installed per manufacturer's installation instructions.

2.16 MEDICAL GAS PIPING (VACUUM PIPING, MEDICAL AIR, NITROUS OXIDE AND OXYGEN PIPING)

- A. Copper Pipe: ASTM B819, Hard Drawn Seamless Medical Gas Tubing Type K or Type L per NFPA 99.
 - 1. Fittings: Wrought copper, socket type, brazed per NFPA 99, ANSI/AWS A5.8.
- B. Protect all piping in concealed locations by installation within a metal or PVC pipe or conduit.

2.17 MEDICAL GAS BALL VALVES

- A. All valves shall be Tri-Tech Medical 51 Series or approved equal by Chemetron and must be installed and tested in strict accordance with NFPA 99 Standards and/or any local codes before use.
- B. The valves shall be bronze, ball-type, with Teflon (TFE) seats and seals. Valves shall be rated at working pressure of 600 psi (29 in/Hg vacuum) and shall be operated by a lever-type handle requiring only a quarter turn from fully open position to a fully closed position. Optional locking handles are available.
- C. All valves shall be equipped with Type K copper tubing extensions with two brass 1/8 NPT female gauge/purge ports (one on each side of the valve), to facilitate installation. Gauge/purge ports shall be shipped with a 1/8 NPT plug. Valves shall be 3-piece in-line repairable type. Valves shall incorporate an adjustable packing and blow-out proof stem. Only full port valves having flow rates comparable to equivalent size of pipe shall be used.
- D. Adhesive backed caution labels shall be acquired separately and field installed. The labels shall state: CAUTION - (GAS NAME) VALVE, DO NOT CLOSE EXCEPT IN EMERGENCY and/or any other required labeling per NFPA 99. Labels shall be color coded for the appropriate gas service and include a section for stating the area being serviced by the valve.
- E. Each valve assembly shall be supplied cleaned for oxygen service in accordance with the current Compressed Gas Association (CGA) Pamphlet G-4.1, ends capped and sealed in a polyethylene bag to prevent contamination prior to installation.

2.18 ZONE VALVE BOX ASSEMBLY

- A. All zone valve boxes shall be the Tri-Tech Medical Z Series or approved equal by Chemetron and shall be installed and tested in strict accordance with NFPA 99 Standards and/or any other local codes before use.
- B. The valves shall be dual gauge port, forged brass, ball-type, with Teflon (TFE) seats and seals. All valves shall be rated at a working pressure of 600 psi (29 in/Hg vacuum) and shall be operated by a lever-type handle, requiring only a quarter turn from a fully open position to a fully closed position. Valves shall incorporate an adjustable packing and a blow-out proof stem. Only full port valves having flow rates comparable to equivalent size of pipe shall be used. Valves shall be able to be piped from left to right or right to left.
- C. All valves shall be provided with Type K copper tubing extensions to facilitate installation. Valves shall be 3-piece in-line repairable type. Each valve assembly shall be supplied cleaned for oxygen service in accordance with current CGA Standards. The valve tube ends shall be capped and sealed in a protective container to prevent contamination prior to installation.
- D. Gauges shall be 1-1/2" diameter for monitoring pressure and vacuum, and shall state: "USE NO OIL". Dual scale gauges are not acceptable for USA installations. A fully color coded label package shall be supplied with each valve box assembly for application by the installer.
- E. The valve box shall be 18 ga sheet steel construction painted to prevent rust. A single box shall house from one to three valves. Boxes may be coupled with other boxes with a part #ZV-801 zone valve box coupler kit. Box shall be supplied with an adjustable plaster flange 1/2" to 1-1/8" for easy mounting.
- F. Valve box assembly shall be supplied with a formed steel decorative frame painted white which encloses and easily removable flexible window. The window shall be a "smoked" translucent flexible plastic with a pull-out ring pre-mounted to the center of the window. The window shall not be replaceable while any valve is in an open position. Window shall be silk screened with the following statement: "CAUTION: MEDICAL GAS SHUTOFF VALVES. CLOSE ONLY IN EMERGENCY."

2.19 MASTER ALARM PANELS

- A. Master alarm panels shall be Chemetron IMPACT Series 74-15 or approved equal by Tri-Tech Medical, Inc.
- B. IMPACT master alarm panels shall be designed to meet the requirements of NFPA and CSA Standards. Alarms shall be UL listed and ULC approved as an assembly and shall include all necessary displays, factory wiring, transformers and circuitry requiring only 115 volt or 230 VAC primary power. Internal voltage shall be stepped down to 15 VDC or control circuit power.
- C. Master alarm panels shall be modular in design. Each panel shall include one or more 10-signal annunciator modules for wiring to remote switches. External switches shall be normally closed (NC) type, per NFPA 99.
- D. Each alarm signal shall be labeled for its function using self-adhesive labels provided with the unit. Adjacent to each signal label shall be a 3-color Light Emitting Diode (LED) to signify condition of the external switch. In the normal state (not in alarm) the LED shall be illuminated green. Activation of any switch will change the LED to red and activate the audible alarm. A "monitor only" state shall also be available. In this state, the LED shall turn yellow when the remote switch opens, with no audible alarm. The LED's shall not illuminate for inputs that are not used.

- E. Each 10-signal annunciator module shall contain an independent/normal/abnormal LED (green for normal and red for abnormal), indicating the overall status of all signals on that module.
- F. The control module shall include a Silence/Enter button, a Test/Shift button, an Up button and a Down button. These buttons shall be used to silence the audible alarm, set up the alarm panel, and to test the alarm panel. The test button shall test all modules one at a time. A LED on the control module shall illuminate green to indicate power on.
- G. The power supply shall be installed in the backbox. Power supply shall include an On/Off rocker switch and fuse holder.
- H. The alarm audio tone shall pulsate, 90 dBA at 2 meters minimum. The audio signal shall be cancelled only by the alarm silence button or fault corrections. Regardless of the audible alarm, the display shall indicate abnormal as long as a fault condition exists. The alarm shall automatically reset with the correction of the fault condition.
- I. The panel shall be equipped with dry contacts for each remote signal, to enable the alarm to interface with another alarm or a central computer system.
- J. The panel shall be equipped with contacts for connection to the PC-based alarm monitoring software. Alarms that require installation of additional circuit boards to allow PC-based monitoring are not acceptable.

2.20 HOT WATER TEMPERATURE MAINTENANCE HEAT TAPE

- A. Furnish and install a complete UL listed system of electrical self-regulating heating and cable components for domestic hot water.
- B. System shall be Raychem "HWAT-Plus" or accepted substitute. The system shall maintain 115°F.
- C. The cable shall be for 208 volt and shall include all components required for a complete system.
- D. Each circuit shall be protected by a 15A ground fault protection device.
- E. Heat tape shall be installed on all hot water piping 3/4" and over and on all 1/2" branches to within 5' of the fixture.
- F. The system shall be tested after installation is complete.

2.21 APPROVED EQUALS

- A. The following are approved equals providing they meet specifications:
 - 1. Drains, Hydrants - Wade, Smith, Ancon
 - 2. Mixing Valves - Powers, Symmons

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry and not over excavated.
- B. Ream pipe and tube ends. Remove burrs.

- C. Remove scale and dirt, on inside and outside, before assembly.
- D. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient.
- D. Install piping to conserve building space and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed.
- I. Establish elevations of buried water piping outside the building to ensure not less than 3' of cover.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- K. Provide support for utility meters in accordance with requirements of utility companies.
- L. Install bell and spigot pipe with bell end upstream.
- M. Install valves with stems upright or horizontal, not inverted.
- N. Pipe vents from gas pressure reducing valves to outdoors and terminate in weatherproof hood.
- O. The Contractor shall provide suitable gas pressure regulators of a type approved by the local gas company. All regulators shall be properly vented to the atmosphere.
- P. The Contractor shall furnish and install wedge type shutoff valves and unions at each piece of gas-fired equipment. Valves shall be installed with handle lever on top when installed in vertical configuration.
- Q. Solenoid valves for auto gas shut-off shall be normally closed type.
- R. Installation of gas piping shall be in accordance with NFPA #54 or National Fuel Gas Code ANSI Z223.1-1980.
- S. Install unions downstream of valves and at equipment or apparatus connections.
- T. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- U. Install ball valves for throttling, bypass, or manual flow control services.

- V. Provide plug valves in Natural gas systems for shut-off service.
- W. Provide flow controls in water recirculating systems where indicated.
- X. Horizontal drainage lines shall be laid to a uniform pitch of 1/4" per foot, if practical, but in no case less than 1/8" to the foot, except where otherwise specifically detailed on the drawings. Each length of pipe and each fitting shall be inspected for defects before installation. Any defective pipe or fitting damaged during or after installation shall be replaced. Each length of pipe shall be laid to bring the inverts to the required line and grade. No stretch of joints will be allowed. All pipe shall be installed to a true straight line. Piping shall be bedded on firm earth foundation of uniform density carefully shaped to fit the lower section of pipe. Each section of pipe shall have a full bearing along its entire length, except at joints where clearance shall be allowed for making up joints. Any length which shows settlement after laying or which is not in true alignment shall be taken up and reset. Under track or roads, the piping shall be run in a standard weight steel pipe sleeve.
- Y. Slope water piping and arrange to drain at low points.
- Z. Cleanouts shall be installed where indicated on the drawings and at all bends, angles, upper terminals, and not over 50' apart in any lineal run of piping. All cleanouts shall be accessible.
- AA. All horizontal sanitary vent piping shall be sloped a minimum of 1/4" per ft.
- BB. All underground sanitary drain piping shall be minimum 2" size.

3.3 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15% of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from outlets and from water entry, and analyze in accordance with AWWA C651.

3.4 OPERATING ADJUSTMENTS

- A. All flush valves shall be adjusted for quiet operation and to pass the required amount of water for the proper flushing action.

3.5 TEST OF WATER SUPPLYING SYSTEM

- A. At the completion of the work, the water supply system must be tested to do a hydrostatic pressure of 50 pounds over the working pressure but not less than 100 pounds to the square inch.
- B. Any water piping run in chases, in walls, or in any way concealed by structural work must be tested to above pressure and proven tight before the pipes are concealed.

3.6 TESTS OF PLUMBING AND DRAINAGE SYSTEMS

- A. The entire system of soil, waste, drain and vent piping must be tested with water or air, as hereinafter described and proved tight to the satisfaction of representatives of Architect/ Engineer before trenches are backfilled, or fixtures connected. Testing instruments must be furnished by the Plumbing Contractor.
- B. When water is used for testing, the drainage system below ground floor shall be filled with water to top of a vertical section of pipe 10' high (except for clay pipe) temporarily connected to the highest point on the lines to be tested. The water shall be allowed to stand for at least 60 minutes for inspection, after which if the lines prove tight, the water is to be drawn off, connection made with the sanitary sewer and trenches backfilled.
- C. All plumbing and drainage piping above the ground floor line must have the openings plugged where necessary and be filled with water to the level of the main roof or tops of vent pipes. The water shall be allowed to stand for at least 60 minutes for inspection, after which if the lines prove tight, the water is drawn off and the fixtures connected.
- D. When air is used for testing, a pressure of not less than 20" of mercury must be maintained without pressure loss for at least 15 minutes. A mercury column gauge must be used in making air tests.

END OF SECTION 230410

SECTION 230440

PLUMBING FIXTURES & EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Water Closets
- B. Lavatories
- C. Sinks
- D. Water Coolers
- E. Urinals
- F. Showers
- G. Water Heater
- H. Circulating Pumps

1.2 REFERENCES

- A. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.
- B. ANSI/ARI1010 - Drinking Fountains and Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

PART 2 - PRODUCTS

2.1 HANDICAPPED WATER CLOSET (P-1)

- A. Furnish and install American Standard elongated water saver Cadet Toilet Model 9468.018. Unit shall be vitreous china with siphon jet action, elongated bowl, 1-1/2" top spud and bolt caps. Unit shall be supplied with Church #5321.112 (black) open front seat and Sloan Royal Optima Model 8111 sensor operated (battery) flush valve 110-1.6. Unit shall be handicapped height.

2.2 LAVATORY (P-2)

- A. Furnish and install wall hung American Standard Lucerne Lavatory Model #0355.012. Unit shall be vitreous china with front overflow, back and side splash shields, "D" shape bowl and faucet holes suitable for concealed arms. Faucet shall be Sloan Optima Model ETF-600 sensor operated electronic and

faucet, 0.5 gpm, ADA, below deck mixing valve. Faucet shall be equipped with a flow restrictor and aerator. Unit shall be supplied with drain, McGuire #8872 adjustable P-trap, #169 flexible supply pipes and installed with carrier for concealed arms. Mount at height as shown on Architectural Drawings. Comply with NSF 61, Section 9.

- B. Contractor shall provide insulation on all exposed pipes under lavatory to comply with ADA and Labor & Industry requirements. Insulation shall be by Truebro or equal.
- C. Provide transformers as required.
- D. Provide lavatory mixing valve Powers Hydro Guard Series LM495 thermostatic mixing valve (or equal).

2.3 SINK (P-3)

- A. Furnish and install Elkay stainless steel single compartment Lustertone Sink Model #LR-2219 with 3 holes on 4" centers. Faucets shall be Delta Model 100 single lever handle with 8" centers, aerator and 2-1/2 gpm flow restrictor. Sinks shall include drain with strainer and tailpiece. Units shall be supplied with McGuire #169 flexible supply pipes and McGuire #8872 adjustable P-trap.

2.4 SINKS (P-4)

- A. Furnish and install Elkay stainless steel double compartment Lustertone Sink Model LR-3321 with 3 holes on 4" centers. Faucets shall be Delta Model #100 single lever handle faucet with 8" centers, aerator and flow restrictor. Sinks shall include drain with strainer and tailpiece. Units shall be supplied with McGuire #169 flexible supply pipes and McGuire #8872 adjustable offset P-trap. Sink shall be 7-1/2" deep.

2.5 WASHING MACHINE CONNECTION BOX (P-5)

- A. Furnish and install washing machine connection unit. Fixture shall be Gray Manufacturing Co., Inc. Model FB200 with 1/2" combination MPT brass sweat connections and 2" drain. Unit shall be for recessed installation and shall be provided with top or bottom supplies as required.

2.6 MOP SINK (P-6)

- A. Mop receptor shall be Model MSB-2424 as manufactured by Powers Fiat, Skokie, Illinois or equal. Color shall be #T-31 - White Drift. The drain body shall be factory installed stainless steel #302 with combination strainer and lint basket. Faucet shall be American Standard Heritage Service sink faucet with Aquaseal valves, renewable seats, 4 arm brass handles, 3/4" threaded hose and spout bucket hook top brace to wall, vacuum breaker, union inlets, adjustable 8" centers, 1/2" female thread, chrome finish. Contractor shall install drain with trap.
- B. Furnish and install with Model #832-AA hose and hose bracket, #889-CC Mop Hanger and #E-77-AA Vinyl Bumper Guard.

2.7 WATER HEATER (P-8)

- A. Water heater shall be Model HE45-100, direct vent, as manufactured by Rheem/Ruud. Unit shall have a gas input of 100,000 Btu/hr. and a recovery rate of 128 gph at 90°F temperature rise. Water heater shall have a storage capacity of 45 gallons and shall have the AGA seal of certification with a

factory supplied AGA rated temperature and pressure relief valve. Tank shall have a coating of high temperature porcelain enamel and furnished with a magnesium anode rod rigidly supported and a boiler-type hand-hole cleanout. Water heater shall meet or exceed the energy factor requirements of ASHRAE Standard 90.1b-1992. Tanks shall have a working pressure rating of 150 psi, and shall be completely factory assembled, including a pressure regulator properly adjusted for operation on natural gas with a cast iron burner. Controls will be arranged for safety shutoff in event of pilot failure. Complete unit shall be insulated with rigid polyurethane foam insulation. Water heater shall be covered by a 10 year limited warranty against tank leaks.

- B. Provide PVC inlet and flue per manufacturers requirements.

2.8 WATER COOLER (P-11)

- A. Furnish and install Barrier Free Universal Split Level Versacooler Water Cooler as manufactured by Ebco Model P8ASCL (Oasis) or equal by Sunroc to cool at least 7.8 gph of water entering at 80°F and leaving at 50°F with room temperature of 90°F. Unit shall have 3 push pad activation, stainless steel top, heavy-gauge galvanized steel frame and a high-efficiency cooling tank and coil. The entire cooler shall be warranted for 5 years. Finish shall be stainless steel. Entire unit shall be "lead-free". Refrigerant shall be R-134a.

2.9 EXPANSION TANK (P-18)

- A. Furnish and install a Taco Model #PAX-84 pressurized diaphragm expansion tank or approved equal. Unit shall be line supported, 11" diameter and 23" in length. Tank shall be ASME stamped, 22 gallons, 12 gallons acceptance volume.

2.10 FLUE VENT PIPING

- A. Flue vent piping shall be Model PS as manufactured by Metal-bestos or approved equal by VanPacker, Metal Fab or Duro-Vent. Piping shall be double wall flue with aluminum coated steel outer jacket and Type 316 stainless steel liner separated by an air space.
- B. Vent piping shall be installed in full compliance with the terms of its UL listing, with manufacturer's installation instructions and with nationally recognized building codes representing good practices for such installation.
- C. The installation shall be continuous from connection to gas-fired equipment outlets up to vent top. Installation shall be complete with flanges, elbows, tees, increasers, drain cap, stack cap, roof thimble and flashing and wall supports for complete system.

2.11 APPROVED EQUALS

- A. The following are approved equals providing they meet specifications:
 - 1. Faucets - Moen, Delta
 - 2. Water Closets, Urinals, Lavatories - Kohler, Eljer, Crane
 - 3. Shower Valves - Powers

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

- B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install each fixture with trap, easily removable for servicing and cleaning.
- C. Provide chrome plated rigid or flexible supplies to fixtures with stops, reducers, and escutcheons.
- D. Install components level and plumb.
- E. Install and secure fixtures in place.
- F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07900, color to match fixture.
- G. Solidly attach water closets to floor with lag screws.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. At completion clean plumbing fixtures and equipment.

3.7 PROTECTION OF FINISHED WORK

- A. Protect finished Work.
- B. Do not permit use of fixtures.

3.8 FIXTURE HEIGHTS

- A. Install fixtures to heights above finished floor as indicated on the Architectural Drawings.

END OF SECTION 230440

SECTION 230510

HVAC PIPING & SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings for Condensate Piping
- B. Valves:
 - 1. Gate Valves
 - 2. Ball Valves
 - 3. Butterfly Valves
 - 4. Check Valves
- C. Expansion Tanks
- D. Air Vents, Air Separators
- E. Pump Specialties

1.2 REFERENCES

- A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
- B. ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- E. ASME B31.9 - Building Services Piping.
- F. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- G. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- H. ASTM B32 - Solder Metal.
- I. ASTM B88 - Seamless Copper Water Tube.
- J. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- K. AWS A5.8 - Brazing Filler Metal.
- L. AWS D1.1 - Structural Welding Code.
- M. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
- N. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- O. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

HVAC PIPING & SPECIALTIES

230510-1

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Use grooved mechanical couplings and fasteners in accessible locations.
- C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- D. Use non-conducting dielectric connections whenever jointing dissimilar metals.
- E. Provide pipe hangers and supports in accordance with ASTM B31.9 unless indicated otherwise.
- F. Use gate, ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- G. Use ball or butterfly valves for throttling, bypass, or manual flow control services.
- H. Use 3/4" ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

1.4 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.
- C. Welders Certificate: Include welders certification of compliance with ASME SEC 9.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Conform to ASME B31.9, ASTM F708, MSS SP89.

2.2 BALL VALVES

- A. Up To and Including 3":
 - 1. Manufacturers:
 - a. Nibco
 - b. Crane

- c. Stockham
- 2. Bronze two piece body, bronze ball, Teflon seats and stuffing box ring, lever handle with balancing stops, solder or threaded ends.

2.3 CONDENSATE PIPING

- A. Copper Tubing: ASTM B88, Type L hard drawn.
 - 1. Fittings: ASME B16.23, cast bronze or ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, solder, Grade 95TA.
- B. PVC Pipe: ASTM D2729
 - 1. Fittings: PVC
 - 2. Joints: ASTM D2855, solvent weld.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water, chilled water piping to ASME B31.9.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls and floors.
- G. Slope piping and arrange to drain at low points.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 230100.
- I. Pipe Hangers and Supports:
 - 1. Install in accordance with ASTM B31.9, ASTM F708 and MSS SP89.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 2" space between finished covering and adjacent work.
 - 4. Place hangers within 12" of each horizontal elbow.
 - 5. Use hangers with 12" minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

- 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
- 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

- J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- K. Provide access where valves and fittings are not exposed.
- L. Slope piping and arrange systems to drain at low points.
- M. Install valves with stems upright or horizontal, not inverted.
- N. Hydronic piping shall be tested with water at 150 psig and system shall not lose over 2 psig in two hours with no visible signs of leakage.
- O. Provide traps at condensate pipe connection to all units.

END OF SECTION 230510

SECTION 230835

HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Rooftop HVAC Unit
- B. Electric Wall Heaters, Cabinet Heaters
- C. VAV Boxes
- D. Central Control Panels

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with provisions of Section 230010.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70 code for internal wiring of factory wired equipment.

PART 2 - PRODUCTS

2.1 VAV SINGLE DUCT TERMINAL UNITS (VAV-1thru VAV-15)

- A. General Unit Information: The unit casing shall be comprised of 22 ga galvanized steel. Outlet connection shall be slip and drive. Agency Listing: The unit shall be UL and Canadian UL listed as a room air terminal unit. UL Control #9N65. Trane terminal units shall be AHRI 880 - 98 certified.
- B. General Unit Clearance: Allow adequate clearance to meet NEC on control box side of unit to meet NEC. A minimum of one and one half duct diameters of straight ductwork, upstream of the air inlet connection, should be present for optimum airflow measurement performance. Upstream ductwork should be the same diameter as the primary inlet connection.
- C. 1" Foil Faced Insulation: The interior surface of the unit casing shall be acoustically and thermally lined with 1", 1.5 lb/cu.ft density glass fiber with foil facing. The insulation shall be UL listed and meet NFPA-90A, UL 181 standards, and bacteriological standard ASTM C665. The insulation R-value shall be 4.1. All cut edges of insulation shall be completely encapsulated in metal to prevent erosion.
- D. Provide air valve size 05, 06, 08, 10 as noted.
- E. Air Valve Round: The air inlet connection shall be an 18 ga galvanized steel cylinder sized to fit standard round duct. A multiple point, averaging flow sensing ring shall be provided with balancing taps for measuring within ±5% of

unit cataloged airflow. An airflow versus pressure differential calibration chart shall be provided. The damper blade shall be constructed of a closed cell foam seal mechanically locked between two 22 ga galvanized steel disks. The damper blade assembly shall be connected through a composite nylon stub axle to a cast zinc shaft supported by self-lubricating bearings. The shaft shall be cast with a damper position indicator. The valve assembly shall include a mechanical stop to prevent over striking. At 4.0" w.g. air valve leakage shall not exceed 1% of cataloged airflow.

- F. Electric Heat Coil: Factory provided and mounted, UL recognized, resistance open-type heater with airflow switch, a disc-type automatic pilot duty thermal primary cutoff, and manual reset load carrying thermal secondary device. Heater element material shall be nickel-chromium. The heater terminal box shall be provided with 7/8" knockouts for customer power supply. Terminal connections shall be plated steel with ceramic insulators. Heater control access shall be left hand. Right hand control access is optional. (Field verify)
- G. Mercury Contactor: Provide an electric heater 24 volt contact for use with Direct Digital Control (DDC) or Analog Electronic VAV Controls.
- H. Power Disconnect Switch (for VCEF): Provide a factory provided interlocking door disconnect switch located on the electric heater control panel.
- I. Line Fuse: Provide a safety fuse located in the electric heater's line of power to prevent power surge damage to the electric heater for VCEF. For VCCF and VCWF, the fuse shall be installed on the primary voltage hot leg in a control box.
- J. Slip & Drive Connection: Provide a slip and drive connection with two straight flanges on the top and bottom, and two drive connections on the left and right sides.
- K. Electric Heat Transformer: Provide a 40VA or 75VA transformer as an integral component of the heater control panel dependent on unit load requirements to provide 24 VAC for controls.
- L. DDC Actuator: Provide Trane 3-wire, 28 ga, 3.4 VA, 1.7W, 24 VAC, 50/60 Hz with floating point quarter turn control actuator with linkage release button. Actuator shall have a constant drive rate independent of load, a rated torque of 35 in-lb, a 90 second drive time and non-spring return. Travel shall be terminated by end stops at fully opened and closed positions. An integral magnetic clutch shall eliminate motor stall. An integral 3 screw terminal shall be provided for field wiring. Operating temperature 21°F to 125°F.
- M. System Communications: The controller shall be designed to send and receive data from a VariTrac Central Control Panel. Current unit status conditions and setpoints may be monitored and/or edited via this data communication feature. The network type shall be a twisted wire pair serial communication.
- N. Direct Digital Controller: The microprocessor based terminal unit controller shall provide accurate, pressure independent control through the use of a proportional integral control algorithm and direct digital control technology. The controller shall monitor zone temperature setpoints, zone temperature and its rate of change, and valve airflow using a differential pressure signal. The controller shall be provided in an enclosure with 7/8" knockouts for remote control wiring. A Trane zone sensor shall be provided.
- O. Override Commands: The following override commands may be received by the Unit Control Module (UCM) from the Tracer System:
 - 1. Control Mode, Action, Offset and Commands:
 - a. Control Mode - Occupied or Unoccupied
 - b. Control Action - Heating or Cooling

- c. Control Offset - Enabling Control Offset will increase the cooling temperature setpoint and decrease the heating temperature setpoint by a control offset value.
- d. Drive damper fully open
- e. Drive damper fully closed
- f. Drive damper to maximum airflow setpoint
- g. Drive damper to minimum airflow setpoint
- h. Disable unit heat
- i. Reset - Enabling the reset function forces the controller and the flow sensor to recalibrate.

P. Editable Setpoints and Functions:

- 1. Occupied and unoccupied cooling temperature setpoint 30°F - 100°F.
- 2. Occupied and unoccupied heating temperature setpoint 30°F - 100°F.
- 3. Maximum flow setpoint (10-100% of unit equivalent cataloged airflow)
- 4. Minimum heating and cooling flow setpoint (0, 10-100% of unit equivalent cataloged airflow)
- 5. Cooling setpoint low and high limit:
 - a. Low: 30°F - 100°F
 - b. High: 30°F - 120°F
- 6. Heating setpoint high and low limit 30°F - 100°F
- 7. Hot water valve drive time
- 8. Air valve drive time

Q. Additional Status Information Available:

- 1. Active cooling setpoint
- 2. Active heating setpoint
- 3. Current unit primary airflow
- 4. Current zone temperature
- 5. Reheat status (on/off)
- 6. Fan status (on/off)
- 7. Calibration status (calibrating/not calibrating)

R. Provide DDC Sensor with setpoint knob and LED display.

2.2 VAV VARITRAC UNITS (BYPASS DAMPERS)

- A. The damper actuator shall be a synchronous motor driven actuator with a 3-wire connection terminal strip and is factory installed. This non-spring return actuator shall have a 53 lb-in running torque, and a 1 minute 90° travel time. The ½" coupler shall fit over the round shaft of the damper. The actuator shall require 2.5 VA at the nominal 24 VAC, 50/60 Hz.
- B. Rectangular Bypass Damper General Data: Damper frames shall be constructed with formed 18 ga galvanized steel, mechanically joined with linkage concealed in the side channel. Self-lubricating nylon bearings shall provide support and alignment for blade movement. The blades shall be 18 ga galvanized steel with 4" of 5" nominal width. These shall be opposed rotation blades set in the frame mounted in a 16" long sheet metal casing. The metal casing shall be constructed of 22 ga galvanized sheet metal, and shall include a pre-formed "S" cleat on each side of the inlet and outlet of the unit. Dampers shall be rated for up to 3000 fpm at 2" of static pressure. The unit shall have an airflow direction label.
- C. Damper: 3100 cfm, 16" x 16" rectangular bypass damper with 4 opposing blades.
- D. Rectangular Damper Actuator: The rectangular damper actuator shall be a synchronous motor driven actuator with a 3-wire connection terminal strip and shall be factory installed. The non-spring return actuator shall have a 35 lb-in running torque, and a 1 minute, 90° travel time. The ½" coupler shall fit over the round shaft of the damper. The actuator shall require 2.5 VA at the nominal 24 VAC, 50/60 Hz.

- E. Direct Digital Controller: The microprocessor based terminal unit controller provides accurate, pressure dependent control through the use of a proportional integral control algorithm and Direct Digital Control technology. The controller monitors zone temperature setpoints, zone temperature and zone temperature rate of change, and the actual damper position. The damper position is digitally controlled to maintain the zone temperature setpoints. A Trane zone sensor is required. Inputs for zone CO2 and space occupancy are provided.
- F. Bypass Damper Control: Bypass damper control is accomplished by a communicating sensor/bypass control assembly that includes a Unit Control Module.
- G. Rectangular Damper Actuator: The rectangular damper actuator is a synchronous motor driven actuator with a 3-wire connection terminal strip and is factory installed. This non-spring return actuator has a 53 lb-in running torque, and a 1 minute. 90° travel time. The ½" coupler fits over the round shaft of the damper. The actuator requires 2.5 VA at the nominal 24 VAC, 50/60 Hz.
- H. System Communications: The Unit Control Module sends and receives data from a VariTrac Central Control Panel via twisted wire pair serial communications. The Central Control Panel issues override commands to the Unit Control Module. Override commands include:
 - 1. Drive damper to minimum position - Heat outputs are enabled
 - 2. Drive damper fully open - Heat outputs are disabled
 - 3. Drive damper fully closed - Heat outputs are disabled
 - 4. Drive damper to maximum position - Heat outputs are enabled for hot water reheat, and disabled for staged electric reheat.
 - 5. Disable unit reheat (hot water and staged electric reheat only).

2.3 CENTRAL CONTROL PANELS

- A. Program Options: Each central control panel shall be individually configurable as either an air conditioner controller or gas heat controller for a VariTrac system.
- B. Outputs: Binary outputs (optional relay board) contacts rated at 0.5A, 30 VAC, 12 VA pilot duty.
- C. Inputs: Binary inputs are provided for occupied/unoccupied and priority shutdown. Each input shall require, should the function be desired, an isolated, ungrounded, remote contact. The contacts must be capable of passing 15 mA of DC current.
- D. Dimensions: 8.67" (220 mm) high, 10.24" (260 mm) wide, 2.61" (66 mm) deep in a plastic enclosure.
- E. Power: 20 to 30 VAC, 30 VA, dedicated external transformer required.
- F. Optional Operator Display: The optional operator display is a backlit, liquid crystal display with touchscreen programming capability. The operator can access system and zone status through the display and perform basic setup of zone VAC UCMS and CCP system operating parameters. The display allows an installer to commission a VariTrac system without using a PC. The operator display has a 7-day time clock for stand-alone scheduling capability.
- G. Operator Display Feature Summary:
 - 1. Backlit LCD touch-screen display for easy operator interface
 - 2. Combination of icon- and menu-based navigation provides intuitive operation.
 - 3. Provides a level of control for the daily operator, and a second level for commissioning and service.

4. Three levels of security are available to protect system settings.
5. Seven-day time clock for stand-alone, time-of-day scheduling.

2.4 ELECTRIC WALL HEATERS (EWH-1)

- A. Electric wall heater shall be Berko Type FRA or accepted substitute by Qmark.
- B. Navajo White Grille shall be 16 gauge steel, with closely spaced downflow discharge bars.

2.5 CABINET HEATERS (ECH-1)

- A. Furnish and install where indicated on the drawings, vertical cabinet, vertical recessed or horizontal recessed style cabinet heaters of the capacity indicated on the schedule. Units shall include galvanized steel chassis, water coil, fanboard, fanwheel, housing, motor, filter and insulation. Units shall be "Force-Flo" Model F (vertical cabinet), Model H (vertical recessed) or Model E (horizontal recessed) as manufactured by Trane, American Air Filter or equal.
- B. Vertical Cabinet Models - Unit shall have 18 gauge steel panels, bottom and end panels with channel-formed edges around entire panel perimeter, stamped outlet grilles with 15° downward deflection, stamped lattice inlet grilles, and bottom panel hinged at front and camlocked at back.
- C. All cabinet parts shall be cleaned, bonderized, phosphatized and coated with baked-on primer and enamel finished in a color selected by the Architect. Access door and front panel shall be tamper-proof.
- D. For electric type, provide electric heating coil with Ni. Chrome element, single stage, UL approved interlocked with fan motor switch.
- E. Provide on-off switch to disconnect power to unit for servicing.

2.6 GAS FIRED ROOFTOP AIR CONDITIONERS (RTAC-1, 2)

- A. General: The units shall be convertible airflow. The operating range shall be between 115°F and 0°F in cooling as standard from the factory for units with microprocessor controls. Operating range for units with electromechanical controls shall be between 115°F and 40°F. Cooling performance shall be rated in accordance with ARI testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410A, and 100 percent run tested to check cooling operation, fan and blower rotation, and control sequence before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be UL listed and labeled, classified in accordance to UL 1995/CAN/CSA No. 236-M90 for Central Cooling Air Conditioners. Canadian units shall be CSA Certified.
- B. Casing: Unit casing shall be constructed of zinc coated, heavy gauge, and galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 672 hours in a salt spray test in compliance with ASTM B117. Cabinet construction shall allow for all maintenance on one side of the unit. All exposed vertical panels and top covers in the indoor air section shall be insulated with a cleanable foil-faced, fire-retardant permanent, odorless glass fiber material. All insulation edges shall be either captured or sealed. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised 1 1/8" high downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting, with forklift capabilities on three sides of the unit.

- C. Unit Top: The top cover shall be one piece construction or, where seams exist, it shall be double-hemmed and gasket-sealed. The ribbed top adds extra strength and enhances water removal from unit top.
- D. Compressors: All units shall have direct-drive, hermetic, scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads shall be provided with the scroll compressors. Crankcase heaters shall be included. Provide dual compressors.
- E. Refrigerant Circuits: Service pressure ports, and refrigerant line filter driers are factory-installed as standard. An area shall be provided for replacement suction line driers.
- F. Evaporator and Condenser Coils: Internally finned, 5/16" copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. Coils shall be leak tested at the factory to ensure the pressure integrity. The evaporator coil and condenser coil shall be leak tested at 600 psig. The assembled unit shall be leak tested to 465 psig. The condenser coil shall have a patent pending 1+1+1 hybrid coil designed with slight gaps for ease of cleaning. A removable, reversible, double-sloped condensate drain pan with provision for through the base condensate drain is standard.
- G. Outdoor Fans: The outdoor fan shall be direct-drive, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motor shall be permanently lubricated and shall have built-in thermal overload protection.
- H. Indoor Fan: All 3-5 ton 1-phase units offer shall be direct drive type. All 3 phase ID motors shall be belt drive type with FC fans with adjustable sheaves. All motors shall be thermally protected. All indoor fan motors meet the U.S. Energy Policy Act of 1992 (EPACT).
- I. Controls: Unit shall be completely factory-wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Unit shall provide an external location for mounting a fused disconnect device. A choice of microprocessor or electromechanical controls shall be available. Microprocessor controls provide for volt control functions. The resident control algorithms shall make all heating, cooling, and/or ventilating decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures. The control algorithm maintains accurate temperature control, minimizes drift from set point, and provides better building comfort. A centralized Microprocessor shall provide anti-short cycle timing and time delay between compressors to provide a higher level of machine protection. Provide high pressure cutout.
- J. Gas Heating Section: The heating section shall have a progressive tubular heat exchanger design using stainless steel burners and corrosion resistant steel throughout. An induced draft combustion blower shall be used to pull the combustion products through the firing tubes. The heater shall use a direct spark ignition (DSI) system. On initial call for heat, the combustion blower shall purge the heat exchanger for 20 seconds before ignition. After three unsuccessful ignition attempts, the entire heating system shall be locked out until manually reset at the thermostat/zone sensor. Units shall be suitable for use with natural gas or propane (field-installed kit) and also comply with the California requirement for low NOx emissions (Gas/Electric Only).
- K. Unit shall be controlled with a 7-day programmable thermostat with multi-stage control and fan control.
- L. Provide throwaway filters.
- M. Provide economizer.

N. Provide roof curb.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Locate baseboard radiation on outside walls and run cover continuously wall-to-wall unless otherwise indicated. Center elements under windows. Install end caps where units butt against walls.
- C. Install convectors and cabinet heaters as indicated. Coordinate to assure correct recess size for recessed convectors.
- D. Locate unit ventilators as indicated, level and shim units, and anchor to structure. Coordinate exact location of wall louvers. Seal airtight around connection of unit vent/ falseback to wall louvers.
- E. Protect units with protective covers during balance of construction.

3.2 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- C. Install new filters.

END OF SECTION 230835

SECTION 230860

VENTILATION EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Exhaust Fans

1.2 REFERENCES

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 261 - Directory of Products Licensed to Bear the AMCA Certified Ratings Seal.
- D. NFPA 70 - National Electrical Code.
- E. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Vapors from Commercial cooking Equipment.
- F. UL 705 - Power Ventilators.

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, sound power levels at rated capacity, and electrical characteristics and connection requirements.

PART 2 - PRODUCTS

2.1 EXHAUST FANS (Inline and Ceiling)

- A. Manufacturers:
 - 1. Penn Ventilator Zephyr
 - 2. Cook
 - 3. Greenheck
 - 4. Acme
- B. Furnish and install ceiling/inline exhaust fans. Units shall be direct drive models. Fans shall have acoustically insulated housing and shall have maximum sound level ratings as noted. Air deliveries shall be as indicated in the schedule and all fans shall bear the AMCA Certified Ratings Seal for air capacities only and the UL label. Manufacturer shall submit vibration amplitudes and magnetic motor hum levels in decibels. Units shall be equipped with integral backdraft dampers which shall be chatterproof. Fans shall have true centrifugal wheels with inlet perpendicular to or remote from inlet grille. Ceiling model grilles shall be aerodynamic design of white eggcrate shape and provide 85% free open area. Terminal box shall be provided with cord, plug, and receptacle inside the housing, entire fan, motor and wheel assembly

shall be removable without disturbing the housing. Motors shall be suitably grounded and mounted on rubber-in-shear vibration isolators.

- C. Furnish Lek-Trol variable speed controller.

2.2 ROOFTOP CENTRIFUGAL EXHAUSTERS

- A. Manufacturers:
 - 1. Penn Ventilator Domex
 - 2. Cook
 - 3. Greenheck
 - 4. Acme
- B. Furnish and install rooftop centrifugal exhausters. Unit shall be direct drive or belt-drive as indicated. Housing shall be heavy gauge spun aluminum, weatherproof, with integral shield. Fan wheel shall be of centrifugal design, statically and dynamically balanced. Fan shall have integral factory-formed base. Housing shall have wiring channel. Unit shall be of direct discharge design. Motor and fan assembly shall be mounted on vibration isolators. Unit shall be equipped with bird screen, backdraft damper, and safety disconnect switch.
- C. Fan shall be mounted on Roof Curb furnished and installed by this Contractor.

2.3 ROOF VENTILATOR HOODS AND ROOF CAPS

- A. Manufacturers:
 - 1. Penn Ventilator Aurette Gravities
 - 2. Cook
 - 3. Greenheck
 - 4. Acme
- B. Roof ventilators shall be of the size shown on the drawing. Vent housing shall be heavy gauge aluminum with hoods designed for intake or exhaust. All vertical seams shall be continuously welded with lock formed seams on hood ends. Hoods shall be stressed and sloped for drainage. Provide aluminum expanded metal bird screen with 85% free area.
- C. Provide an insulated fabricated UniBeam roof curb, and backdraft damper (relief/exhaust only).
- D. Roof caps shall be Penn Model 11FR. Mount roof cap on roof curb.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb.
- D. Install flexible connections where indicated.
- E. Provide sheaves required for final air balance.
- F. Install backdraft dampers on inlet to roof exhausters.

- G. Provide backdraft dampers on outlet from cabinet and ceiling exhausters fans and as indicated.
- H. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION 230860

SECTION 230890

DUCTWORK SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal Ductwork
- B. Nonmetal Ductwork
- C. Duct Cleaning
- D. Air Turning Devices/Extractors
- E. Backdraft Dampers
- F. Combination Fire and Smoke Dampers
- G. Duct Access Doors
- H. Fire Dampers
- I. Flexible Duct Connections
- J. Volume Control Dampers
- K. Duct Silencers
- L. Diffusers
- M. Registers/Grilles
- N. Louvers

1.2 REFERENCES

- A. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- B. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- C. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- D. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- E. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- F. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.
- G. SMACNA - HVAC Air Duct Leakage Test Manual.
- H. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

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- I. SMACNA - Fibrous Glass Duct Construction Standards.
- J. UL 181 - Factory-Made Air Ducts and Connectors.
- K. UL 33 - Heat Responsive Links for Fire-Protection Service.
- L. UL 555 - Fire Dampers and Ceiling Dampers.
- M. ASHRAE Handbook - Systems Volume, Chapter "Sound and Vibration Control".
- N. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Ductwork:
 - 1. Shop Drawings:
 - a. Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for kitchen hood exhaust systems.
 - b. The contractor shall submit for checking and approval, copies of his shop drawings of ductwork for the main trunk duct systems, and must receive approval of the Architects before any fabrication upon this ductwork is begun.
 - 2. Product Data: Provide data for duct materials and duct connectors.
- C. Ductwork Accessories:
 - 1. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, fire dampers, duct silencers, etc.
 - 2. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, fire dampers, duct silencers, etc.
 - 3. Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.
- D. Air Outlets and Inlets: Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- B. Test and rate louver performance in accordance with AMCA 500.

1.5 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A and NFPA 96 standards.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

- A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90.

- B. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.
- C. Insulated Flexible Ducts:
 - 1. Manufacturers:
 - a. Johns Manville Model Micro-Aire J/FLXSL.
 - b. Wiremold Model M-KH.
 - c. Automation Industries Flexible Tubing Div. Model Thermaflex.
 - 2. Flexible round ductwork shall consist of a vinyl coated spring steel helix bonded to a vinyl coated fiberglass liner wrapped with fiberglass wool insulation providing a thermal conductance of 0.23 Btu./hr./sq. ft./°F. Outer jacket shall be reinforced metalized mylar/neoprene laminate. Ducts shall be "Thermaflex" as manufactured by Automation Industries Flexible Tubing Division Type M-KH or type VTKC as manufactured by the Wiremold Company, suitable for an operating temperature from 0°F to 180°F and 2" wg. Clamps, connectors and the installation shall be as recommended by the manufacturer. Ducts shall be listed by UL under their UL-181 standards as Class 1 air duct and comply with NFPA Standard No. 90A.

2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Construct T's, bends, and elbows with radius of not less than 12 times width of duct on centerline. Provide turning vanes in all elbows. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- C. Increase duct sizes gradually, not exceeding 15° divergence wherever possible; maximum 30° divergence upstream of equipment and 45° convergence downstream.
- D. Provide standard 45° lateral wye takeoffs unless otherwise indicated where 90° conical tee connections may be used.

E. Size shall be as follows:

1. Rectangular Duct:	
<u>Largest Duct Dimension</u>	<u>Steel U.S. Standard Gauge</u>
Up through 12"	26
13" through 30"	24
30" through 54"	22
55" through 84"	20
84" and above	18
2. Round Duct (Exhaust System Only)	
<u>Largest Duct Dimension</u>	<u>Steel U.S. Standard Gauge</u>
Up through 8"	26
9" through 22"	24
23" through 36"	22
37" through 50"	20

2.3 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.4 BACKDRAFT DAMPERS

- A. Gravity Backdraft Dampers, Size 18 x 18" (450 x 450 mm) or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturers' standard construction.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 16 gage thick galvanized steel, with blades of maximum 6" width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90° stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.5 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum 1" (25 mm) thick insulation with sheet metal cover.
 - 1. Less Than 12" Square: Secure with sash locks.
 - 2. Up to 18" Square: Provide two hinges and two sash locks.
 - 3. Up to 24x48": Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Provide an additional hinge.
- C. Access doors with sheet metal screw fasteners are not acceptable.

2.6 FIRE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- B. Ceiling Dampers: Galvanized steel, 22 gauge frame and 16 gauge flap, two layers 0.125" ceramic fiber on top side, with locking clip.
- C. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations and closure under air flow conditions. Configure with blades out of air stream. Similar to Ruskin Model IBDZ from Dynamic Systems.
- D. Fusible Links: UL 33, separate at 160°F with adjustable link straps for combination fire/balancing dampers.

2.7 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
 - 2. Net Fabric Width: Approximately 2" (50 mm) wide.
 - 3. Metal: 3" wide, 24 gage (0.6 mm thick) galvanized steel.

2.8 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

- B. Single Blade (up to 12" high) - 16 gauge blade on rod.
- C. Multi-Blade Damper (over 12" high): Fabricate of opposed blade pattern with maximum blade sizes 8 x 72" Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- D. End Bearings: Except in round ductwork 12" (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- E. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30" provide regulator at both ends.

2.9 RECTANGULAR CEILING DIFFUSERS

- A. Manufacturers:
 - 1. Tuttle & Bailey, Agitair Model RC
 - 2. E.H. Price - SMX
 - 3. Metalaire - Series 5000
 - 4. Titus TDV
- B. Type: Square and rectangular, multi-louvered diffuser to discharge air in pattern as indicated on drawings.
- C. Frame: Surface mount type.
- D. Fabrication: Steel or aluminum with baked enamel off-white finish.
- E. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.10 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Agitair Model EDGO
 - 2. Acceptable equal by Anemostat, Titus, Carnes, Metalaire, Krueger provided specifications are met.
- B. Type: Streamlined blades, 3/4" minimum depth, 3/4" maximum spacing, with blades set at 45° horizontal face.
- C. Frame: 1-1/4" margin with countersunk screw mounting.
- D. Fabrication: Aluminum extrusions, with factory off-white enamel finish, color to be selected.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.
- F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.11 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:

1. Tuttle & Bailey, Agitair Model RUGO.
 2. Approved equal by Anemostat, Titus, Carnes, Metalaire, Krueger
- B. Type: Streamlined blades, 3/4" minimum depth, 3/4" maximum spacing, with spring or other device to set blades, vertical face.
- C. Frame: 1-1/4" margin with countersunk screw mounting.
- D. Fabrication: Aluminum extrusions, with factory off-white enamel finish, color to be selected.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Rectangular ductwork shall be galvanized unless otherwise noted.
- B. Provide aluminum ductwork for dishwasher exhaust system and for shower room branch ductwork.
- C. Provide interior epoxy or coated galvanized round ductwork for Fume Hood Exhaust Systems and Dark Room Fan Systems.
- D. Install in accordance with manufacturer's instructions.
- E. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- F. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- H. Use double nuts and lock washers on threaded rod supports.
- I. Connect terminal units to supply ducts with 1' maximum length of flexible duct. Do not use flexible duct to change direction.
- J. Connect diffusers to low pressure ducts with 8 feet maximum length of flexible duct held in place with strap or clamp. (Concealed areas only.)
- K. Connect flexible ducts to metal ducts with adhesive.
- L. Set plenum doors 6 to 12" above floor. Arrange door swings so that fan static pressure holds door in closed position.
- M. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- N. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- O. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

- P. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Provide minimum 8x8" size for hand access, 18x18" size for shoulder access, and as indicated. Provide 4x4" for balancing dampers only. Review locations prior to fabrication.
- Q. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- R. Demonstrate resetting of fire dampers to Owner's representative.
- S. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- T. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- U. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
- V. Support duct silencers independent of ductwork.
- W. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- X. Install diffusers to ductwork with airtight connection.
- Y. Paint ductwork visible behind air outlets and inlets matte black.

3.2 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.3 SHEET METAL WORK

- A. Provide air duct systems as shown on the drawings. Construction methods, unless otherwise specified, shall conform with the recommendations in the latest edition of the ASHRAE Guide. Unless otherwise noted, ductwork shall be galvanized steel.
- B. All ductwork seams and joints shall be caulked with white silicone caulking and taped before caulking compound cures. In lieu of caulk and tape, ductwork may be sealed with Benjamin Foster #30-02 duct seal or Cadoprene #725 installed per manufacturer's instructions.
- C. For use on ductwork 18" size and larger in any dimension, the system shall consist of angles, corners, PCV cleats, gaskets and corner clips. Install the system in accordance with the manufacturer's instructions and installation manuals. Joints shall meet SMACNA Type "J" connection for Systems 35 and SMACNA Type "E" for System 25. Duct connection system shall be similar to "Ductmate" by Ductmate Industries, Inc.

- D. All branch connections shall be made in a manner that leaves no exposed liner edges.
- E. No pipe or conduit and no hangers for ceilings or piping shall pass through ducts unless it is impossible to avoid doing so, in which case, the approval of the Architects shall be obtained before proceeding with the work.
- F. Should vibrations occur in ductwork while the system is in operation, this contractor shall install such additional stiffening members as are necessary to overcome this vibration. All ductwork where vibration occurs shall be isolated at points of contact with the building by felt pads neatly and securely held in place. The ductwork at a manually or automatically operated damper shall be reinforced to properly support the damper and prevent vibration. Curved elbows shall have a centerline radius of not less than 12 times the width of the duct.
- G. All work shall be designed and fabricated to keep resistance losses to a minimum. Use gradual transformation and long radius elbows. Where sharp turns are necessary, the elbow or plenum shall be fabricated with vanes concentric with the inside and outside radii.
- H. Where indicated and where required for proper system air balancing, furnish and install opposed blade adjustable volume dampers as hereinafter specified.
- I. Volume dampers are to be key operated opposed blade type and are to be operable from the bottom.

3.4 HANGERS

- A. Ductwork shall be rigidly supported and secured in an approved manner to the structure, reinforced and braced to be free from vibration, rattle and noise. Hangers shall be securely suspended from structure.
- B. Hanger schedule shall be as follows:
 - 1. Duct up to 20" wide: Galvanized band or strap iron not less than 12 gauge not less than 1" wide - 8' centers.
 - 2. Ducts 21 to 36" wide: 12"x12" x 1/8" angle iron and 3/8" threaded rod - 8' centers.
 - 3. Duct 36" wide: 12"x12" x 3/16" angle iron and 2" threaded rod - 6' centers.

3.5 DUCT ACCESS DOORS AND FIRE DAMPERS

- A. Access doors shall be provided in ductwork and walls and ceilings where required for adjustment of manual dampers and fire dampers. Access doors shall be furnished by this contractor for installation by the General Contractor. Access doors must meet fire rating requirements of associated wall or ceiling.
- B. Fire dampers shall in all cases be accessible with suitable means provided for replacing fusible links. Where no other means are available, access doors shall be provided in ductwork.

END OF SECTION 230890

SECTION 230900

ATC SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Control Equipment & Wiring
- B. Sequence of Operation

1.2 SCOPE OF WORK

- A. Furnish and install a complete electronic/electric system of automatic temperature controls for controlling all equipment as herein specified or implied.
- B. The Contractor shall submit complete temperature control diagrams with written "sequence of operation" and factory-printed specification data sheets covering each control device proposed to be used for engineer's approval prior to installation of any equipment or part of system.
- C. The manufacturer of the control equipment shall guarantee all materials and workmanship furnished by same for a period of 1 year after acceptance of the complete control system by the Owner. Normal system maintenance or readjustment of components after such time shall not be part of the guarantee.
- D. All thermostats indicated shall be protected by tamperproof metal protective guards with keylocks supplied and installed by the Contractor.
- E. The system shall be installed complete by the ATC Sub-Contractor.
- F. All automatic dampers shall be furnished and installed by the Mechanical Contractor, or his sheetmetal subcontractor.
- G. All electrical control wiring required for the temperature control system, including electrical interlock wiring, shall be provided by the Contractor. All wiring for temperature control system as herein specified shall be in accordance with all National and Local Electrical Code requirements.
- H. The "Scope of Work" to be performed under this Contract shall be used as a guide only and will not be considered as the limit of this contract. Any additional items which are not specifically called for but which are required by the specification shall be furnished and installed by the contractor without additional cost.

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Shop Drawings:
 - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - 2. List of connected data points, including connected control unit and input device.

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3. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 4. System configuration with peripheral devices, batteries, power supplies, diagrams, and interconnections.
 5. Descriptive data and sequence of operation of operating, user, and application software.
 6. Minimum requirements for Owner supplied hardware.
- C. Product Data: Provide data for each system component and software module including catalog sheets, specifications, wiring, damper and valve schedule, flow diagram of system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The control system shall be as manufactured by Trane or approved equal.

2.2 CONTROL EQUIPMENT

- A. Control Cabinets: Control cabinets shall be constructed of heavy gauge steel. Unless otherwise specified, all controllers, electric relays switches, and other equipment furnished as part of the control system which are not required to be mounted on mechanical equipment, shall be cabinet-mounted. All devices specified or noted to be mounted within cabinets shall be mounted on the rear subpanel. All devices specified or noted to be mounted on front of the panel shall be flush mounted on the cabinet. All electrical devices shall be wired to a numbered terminal strip and all pneumatic devices shall be completely factory-piped, adjusted and checked for proper operation prior to shipment to job site.
- B. Electric High-Limit Control: Electric high-limit control shall be designed to be mounted in air handling duct systems and wired to shutdown and "lock-out" air conditioning or ventilating fans when air temperature goes above a preset limit. Controls shall require manual reset to restart the fan. Range shall be 25°F to 215°F and setpoint shall be adjustable by a calibrated knob located on the front of the case. Using this control with the standard stop setting of 125°F. Shall conform to Section 172, SBFU Pamphlet No. 90A.
1. Sensing element shall be installed horizontally back and forth across coil face. Operation shall not be affected by ambient temperature changes at controller's case.
- C. Dampers and Motors: Automatic dampers shall be of the modular type. Frames shall be a combination of 13-gauge, formed galvanized steel channels, together with corner brackets riveted to the channels, to form a damper that is rigid and always in perfect alignment. To withstand high velocities, blades shall be formed into two halves and resistance-welded together. Square blade shall be precisely made to fit the blade and shall assure positive blade pivoting without slippage. Bearings shall be made from oil-impregnated bronze. Seals on blade tips and on top and sides of the damper shall be made from Buyle rubber and shall withstand temperatures from -20_F to 200_F. Blade linkage shall be located within the damper frame, Two linkage arrangements shall be available. One for variable pressure drop applications and one for relatively constant pressure drop applications, as required, to provide a near linear characteristic for any application. Leakage through the closed damper shall be less than 0.45% at 4% WG pressure differential, based on 1500 FPM open damper approach velocity.
1. Damper motors shall be electric or electronic motors, capable of modulating automatic dampers in response to a varying signal from a

control device. Actuators shall be capable of being used for either gradual or two-position action. Motors shall be large enough to operate dampers positively, efficiently, and smoothly.

D. Thermostats (GUH, GF-3/CU-3, ECH-1, ECH-2):

1. Thermostats shall be 7-day programmable type with LED Temperature Display and setpoint adjustment features.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install electrical work in accordance with NEC. Electrical material and installation shall be in accordance with appropriate requirements of Division 16.
- C. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- D. Provide service engineer to instruct Owners representative in operation of system.
- E. Provide basic operator training.
- F. The control equipment shall be installed in a neat and workmanlike manner. All conduit shall be run parallel to or at right angles to the building structure and shall be concealed in all finished spaces.

3.2 OPERATION AND ADJUSTMENT

- A. On completion of the job, the Contractor shall have completely adjusted the entire control system. He shall arrange to instruct the Owner's representative in the operation of the control system and supply him with three copies of the control operating and instruction manual. He shall obtain from the Owner's representative a signed receipt that he has received the instruction manuals and complete instructions on the operation of the system.
- B. The control system herein specified shall be free from defects in workmanship and material under normal use and service. After completion of the installation, the control manufacturer shall regulate and adjust all thermostats, control valves, control motors and other equipment provided under his contract. If within twelve (12) months from the date of acceptance of any of the equipment herein described is proved to be defective in workmanship or materials, it will be replaced or repaired free of charge.
- C. The Contractor shall, after acceptance, provide any service incidental to the proper performance of the control system under guarantees outlined above for the period of one year. Normal maintenance of the system or adjustments of components is not to be considered part of this guarantee.

3.3 CONTROL OF RTAC/VAV SYSTEMS

- A. General: High limit control, mounted in discharge air supplies shall, upon sensing alarm conditions, completely shut down the unit supply fan, heating section and close outside air damper. The responsibilities of the ATC Contractor are to provide installation of all factory provided controls and to

provide any controls as required to perform the specified sequence of operation.

- B. The ATC System for the VAV Units shall include the following:
 - 1. (2) Central Control Panels; (1) for each system
 - 2. (15-field verify) VAV boxes/Varitrac boxes each with a unit control module.
 - 3. (15 - field verify) DDC Zone Sensors with setpoint and occupancy.
 - 4. (2) VAV Changeover Bypass Units
 - 5. (2) VAV Changeover Bypass System Controllers
 - 6. Interconnecting wiring.
 - 7. Start-up and programming by factory authorized personnel.
- C. The gas furnace section shall provide morning warm-up and heating when all zones in a system are calling for heating.
- D. The DX cooling section shall provide cooling.
- E. The integral electric heater or duct mounted electric heater shall provide heating when the system is in the cooling mode and that zone requires heating or reheat.
- F. When a system is in the occupied mode, the ATC damper for outside air from the associated HRU unit shall be fully open.

3.4 SYSTEM CONTROL

- A. The central control panel scans the VAV and VariTrac unit control modules to determine the deviations from temperature setpoint, time of deviation, time from last changeover and number of unit control modules requiring heating or cooling. Based upon this information, the system heat/cool mode is selected. The central control panel also monitors the system air temperature to determine capacity staging and to ensure that high and low temperature limits are not violated.
- B. System temperature control is accomplished by switching relays to sequence either the gas furnace or air conditioning unit.
- C. The central control panel also controls system static air pressure to the design pressure by opening and closing the bypass damper. Bypass damper control is accomplished via a communications link.
- D. The systems sixth binary output can be configured to disable outside air ventilation during the unoccupied mode, reflect the system heat/cool status, or be controlled by an ICS System.
- E. Control Options: The following control options are selectable at the central control panel:
 - 1. Priority Shutdown: The central control panel will go into priority shutdown when the supply air temperature sensor fails, when communication to the communicating sensor/bypass control is lost, or when contacts connected to the priority shutdown binary input are closed.
 - 2. Air Conditioning Unit Control: When configured as a 2 heat/2 cool controller, the binary outputs are designated as follows:
 - a. Fan
 - b. Cool 1
 - c. Cool 2
 - d. Heat 1
 - e. Heat 2

3. Heat Control: When configured as a heat controller, the binary outputs are designated as follows:
 - a. Fan
 - b. Gas Furnace
 - c. Auxiliary Heat

3.5 VAV BOX CONTROL

- A. DDC Sequence of Operation: The unit controller continuously monitors the zone temperature against its setpoint and varies the primary airflow as required to meet zone setpoints. Airflow is limited by minimum and maximum airflow setpoints.
- B. DDC Controls Option DD04, DD14, DD44: Basic Operation: On/Off staged Electric Heat (Normally open Outputs) (DDC/UCM): A voltage signal from the zone sensor indicates the zone temperature is used by the unit controller to determine an error from the setpoint. This error, as well as primary flow differential pressure, is used to determine damper position within minimum and maximum cooling airflow setpoints. As the zone temperature drops to the heating setpoint, primary airflow is controlled to minimum heating flow setpoint. Staged electric heat is energized.
- C. DDC Zone Sensor with Setpoint & Occupancy: This electronic device utilizes a thermistor to vary the voltage output in response to changes in the zone temperature. Wiring to the U.C.M. controls must be 18 to 22 awg shielded twisted pair wiring. The setpoint adjustment range is 50°F - 88°F. This sensor is provided with an externally adjustable setpoint, a timed override button and a timed override cancel button. An optional communications jack is available which snaps into the enclosure backplate.
- D. Each VAV box shall have a direct digital controller. Multiple VAV boxes controlled by single controller shall not be acceptable. Service technician shall be able to view, change and program all points associated with VAV box from portable service tool plugged into space sensor or at computer.
- E. During the occupied mode, primary air control damper shall modulate to maintain space temperature. On a call for heat, air control damper shall go to heat position and reheat coil valve shall modulate to maintain space temperature setpoint.
- F. System operator shall be capable of reading primary air CFM at each VAV box from central operator workstation through air monitoring device.

3.6 VARITRAC BOX CONTROL

- A. Sequence of Operation:
 1. The Unit Control Module shall continuously monitor the zone temperature against its setpoint and varies the primary airflow as required to meet zone setpoints. Airflow is limited by minimum and maximum position setpoints.
 2. The Central Control Panel broadcasts the supply air temperature to the Unit Control Modules, which then changes the control action to cooling or heating as appropriate. When staged electric reheat is present, remote heat will be disabled when the Unit Control Module is in heating control action.
 3. Electric reheat is energized with on/off, staged outputs.
- B. DDC Zone Sensor with Setpoint & Occupancy: This electronic device utilizes a thermistor to vary the voltage output in response to changes in the zone temperature. Wiring to the U.C.M. controls must be 18 to 22 awg shielded

twisted pair wiring. The setpoint adjustment range is 50°F - 88°F. This sensor is provided with an externally adjustable setpoint, a timed override button and a timed override cancel button. An optional communications jack is available which snaps into the enclosure backplate.

- C. Sensor Enclosure: The sensor enclosure consists of back plate, cover, security screw, batteries, and mounting hardware. It provides openings for ventilation, switches, and indicators. A security screw is located at the bottom of the enclosure and anchors the cover to the back plate to help prevent tampering.
- D. Each VAV box shall have a direct digital controller. Multiple VAV boxes controlled by single controller shall not be acceptable. Service technician shall be able to view, change and program all points associated with VAV box from portable service tool plugged into space sensor or at computer.
- E. During the occupied mode, primary air control damper shall modulate to maintain space temperature. On a call for heat, air control damper shall go to heat position and reheat coil valve shall modulate to maintain space temperature setpoint.
- F. System operator shall be capable of reading primary air CFM at each VAV box from central operator workstation through air monitoring device.

3.7 CONTROL OF EXHAUST FANS

- A. EF-2 (111), EF-1 (121) - Fan shall be controlled by reverse acting thermostat.
- B. EF-1, 2 - Fan shall be controlled by tie-in with light switch. Provide 10 minute time delay after lights are turned off.
- C. EF-2 (118) - Fan shall run continuously.

3.8 CONTROL OF ECH UNITS, GUH

- A. ECH units shall be controlled by a 7-day programmable thermostat.

3.9 CONTROL OF EWH

- A. Units shall be controlled by a self-contained thermostat.

END OF SECTION 230900

SECTION 230990

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing, Adjustment, and Balancing of Air Systems
- B. Testing, Adjustment, and Balancing of Hydronic Systems
- C. Measurement of Final Operating Condition of HVAC Systems

1.2 REFERENCES

- A. AABC - National Standards for Total System Balance.
- B. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- C. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- C. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- D. Provide reports in binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- E. Test Reports: Indicate data on Standard AABC or NEBB Forms.

1.4 QUALIFICATIONS

- A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with AABC or NEBB Certification.

1.5 SEQUENCING

- A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 AGENCIES

- A. By Mechanical Contractor

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance as soon as observed.
- C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations.
- B. Provide additional balancing devices as required.

3.4 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within $\pm 5\%$ of design for supply systems and $\pm 10^\circ$ of design for return and exhaust systems.
- B. Hydronic Systems: Adjust to within $\pm 10\%$ of design.

3.5 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. Recheck points or areas as selected and witnessed by the Owner.

3.6 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions.

END OF SECTION 230990

SECTION 260010

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to all Division 26 Specification Sections.

1.2 SCOPE OF PROJECT

- A. Provide a complete and operating electrical installation in accordance with these specifications and accompanying contract drawings. This includes all required labor, materials, apparatus and supervision.

1.3 UNIT PRICE ITEMS

- A. Include all allowances in the Base Bid and complete the Unit Cost Area on the Bid Form for each item described below.
 - 1. The quantities in each item are in addition to the items shown on the drawings. The Owner and/or Architect will locate these items in the field when the Owner feels that they are needed.
 - 2. All allowance items included in the contract that are not installed will be credited to the Owner at the closeout of the contract at the Unit Price cost.
- B. Unit Price #E1 - Duplex Receptacle & Wiring:
 - 1. Description: Provide an additional duplex receptacle assembly. Include 20A, 120V duplex receptacle, backbox, cover plate, ¾" conduit/raceway with 2 #12 conductors and 1 #12 ground wire to a point of authorized connection, necessary wall penetration cutting and patching, terminations and labeling. Perform in accordance with applicable Division 26 Sections and drawing requirements for similar work.
 - 2. Unit of Measurement: Per assembly
 - 3. Maximum Distance: 75 feet
 - 4. Quantity Allowances: Include 10 assemblies
- C. Unit Price #E2: Data Outlets and Wiring:
 - 1. Description: Provide an additional C4 data outlet as detailed on the Drawings consisting of backbox, jacks, plate, cabling, patch panel port, conduit, all terminations and labeling; warranty shall be included on this outlet. Perform in accordance with applicable Division 26 Sections and drawing requirements for similar work.
 - 2. Unit of Measurement: Per assembly
 - 3. Maximum Distance: 300 feet
 - 4. Quantity Allowances: Include 5 assemblies

1.4 RULES AND REGULATIONS

- A. Perform in accordance with the rules and regulations of the National Electrical Code (NEC), International Building Code (IBC) and other Codes and Standards cited in this specification and the requirements of the utility companies serving the project site.

ELECTRICAL GENERAL REQUIREMENTS

260010-1

- B. Certificates of Approval in triplicate, for rough and finished wiring, from a Certified Inspection Service must be delivered to the Engineer before final payment can be authorized.
- C. Perform all work in accordance with the rules and regulations of the Pennsylvania Department of Labor and Industry, Federal Department of Labor (Occupational Safety and Health Administration) and any other national, state, or local authority having jurisdiction.
- D. Perform all Construction, design, fabrication, tests, rating, and installation in compliance with the regulations of all local, state or national agencies having jurisdiction over the project. Pay all costs involved in work necessary to comply with these regulations.
- E. The Contractor assumes all responsibility and liability for any code violations, damage or injury which occurs as a result of a deviation from or a change to the requirements of these plans and specifications which has not been approved in writing by the Engineer.
- F. Consider the National Electrical Code, and the other codes and standards cited herein as providing the minimum construction standards for this project. Conform to all additional requirements and limitations contained in these plans and specifications as indicated.
- G. The intent of these drawings and specifications is to define the scope-of-work and standards of quality for the project. The Contractor is responsible for understanding and following the requirements of the codes and standards referenced by these documents. The Contractor shall be responsible for costs associated with changes when a code enforcement official determines that work does not comply with referenced codes and standards.

1.5 DEFINITIONS

- A. General - Basic Contract definitions are included in the Conditions of the Contract.
- B. Indicated - The term indicated refers to graphic representations, notes, or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as shown, noted, scheduled, and specified are used to help the reader locate the reference. There is no limitation on location.
- C. Directed - Terms such as directed, requested, authorized, selected, approved, required, and permitted mean directed by the Architect, requested by the Architect, and similar phrases.
- D. Approved - The term approved, when used in conjunction with the Architect's action on the Contractor's submittals, applications and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract.
- E. Regulation - The term regulation includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. Furnish - The term furnish means supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation and similar operations.
- G. Install - The term install describes operations at the Project site including the actual unloading, unpacking, assembly, erection, placing, anchoring,

applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

- H. Provide - The term provide means to furnish and install, complete and ready for the intended use.
- I. Contractor - The Contractor or Electrical Contractor - The term means the Contractor responsible for all work under this Division.
- J. Installer - An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
1. The term experienced, when used with the term installer, means having a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
 2. Trades - Using terms such as carpentry is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
 3. Assigning Specialists - Certain Sections of the Specifications require that specific construction activities are performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no choice or option. However, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.
 - a. This requirement is not to be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.
- K. Project Site is the space available to the Contractor for performing construction activities either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the drawings and may or may not be identical with the description of the land on which the Project is to be built.
- L. Testing Agencies - A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.
- M. AHJ - Authority(ies) Having Jurisdiction
- N. Abbreviations and Names - Trade association names and titles of general standards are frequently abbreviated. The following acronyms or abbreviations, as referenced in Contract Documents, are defined to mean the associated names.
1. AAHTO American Assoc of State Highway & Trans Officials
 2. ACI American Concrete Institute
 3. AISC American Institute of Steel Construction
 4. AISI American Iron and Steel Institute
 5. ANSI American National Standards Institute
 6. ASTM American Society for Testing and Materials
 7. AWS American Welding Society
 8. CBM Certified Ballast Manufacturers Assoc.
 9. CRSI Concrete Reinforcing Steel Institute
 10. EIA Electronic Industries Assoc.
 11. ETL ETL Testing Laboratories Inc.
 12. FM Factory Mutual Research Organization
 13. ICEA Insulated Cable Engineers Association, Inc.

- 14. IEC International Electrotechnical Commission
- 15. IEEE Institute of Electrical and Electronic Engineers
- 16. IESNA Illuminating Engineering Society of North America
- 17. IMSA International Municipal Signal Association
- 18. ISA Instrument Society of America
- 19. LPI Lighting Protection Institute
- 20. NEC National Electrical Code
- 21. NECA National Electrical Contractors Assoc.
- 22. NEMA National Electrical Manufacturers Assoc.
- 23. NETA International Electrical Testing Assoc.
- 24. NFPA National Fire Protection Assoc.
- 25. UL Underwriters Laboratories, Inc.

O. Federal Government Agencies - Names and titles of federal government standard- or Specification-producing agencies are often abbreviated. The following acronyms or abbreviations referenced in the Contract Documents indicate names of standard- or Specification-producing agencies of the federal government. Names and addresses are subject to change but are believed to be, but are not assured to be, accurate and up to date as of the date of the Contract Documents.

- 1. CFR Code of Federal Regulations
- 2. EPA Environmental Protection Agency
- 3. FAA Federal Aviation Administration (US Department of Transportation)
- 4. FCC Federal Communications Commission
- 5. FS Federal Specification (from GSA); Specifications Unit (WFSIS)
- 6. MIL Military Standardization Documents (US Department of Defense)
- 7. Naval Publications and Forms Center
- 8. OSHA Occupational Safety and Health Administration (US Department of Labor)
- 9. REA Rural Electrification Administration (US Department of Agriculture)

1.6 DRAWINGS

- A. The accompanying drawings are a part of the contract documents and are intended to show approximate and relative locations of services and equipment. Do not scale drawings to determine exact positions, locations, and clearances.
- B. Due to the diagrammatic layout and small scale of the drawings exact dimensions are not shown. Coordinate location and position of equipment with all other trades and the Engineer. Bring any discrepancies or interferences to the attention of the Architect and/or Engineer for clarification.
- C. All drawings and specifications pertaining to general construction, plumbing, HVAC, kitchen, electrical and other work shall be carefully examined. Where physical interferences with his work occur because of his failure to coordinate with other trade, this Contractor shall rearrange his work at his own expense.

1.7 SUBMITTAL OF SHOP DRAWINGS FOR REVIEW

- A. Submit shop drawings with a letter of transmittal to the Architect per requirements of the General Conditions and Architects instructions.
- B. Properly prepare submittals before transmitting to the designated reviewer.
 - 1. Prepare an individual submittal package for each related group of materials.
 - 2. Refer to individual 260000 Sections for materials to be submitted for review and approval.
 - 3. Collate all items to be submitted as required by Division 1 consisting of one copy of each item. Permanently bind together by staples or other means all pages in each set.

4. Bind with each set a typed cover sheet showing the date, project name, project location, Engineer's name, Contractor's name, Specification Section and an index of all items included.
 5. Provide space on the cover sheet for the approval stamps of the Subcontractor, Contractor, Engineer and Architect. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
 6. Clearly mark each page in the submittal set to show the manufacturer's name.
 7. When a page shows more than one item or catalog number, mark the item and catalog number which is proposed for use. Show all accessories, options and appurtenances which are required or which the Contractor desires to use.
 8. Improperly prepared submissions will be returned without action.
- C. All disapproved submittals shall be corrected as directed by the Architect/Engineer and resubmit the same quantity as originally submitted until approved. No work involving any materials or equipment covered by shop drawings shall be started until the respective shop drawings are approved.
- D. All items requiring shop drawing review shall not be installed until final approval has been given by the Architect/Engineer.

1.8 SUBSTITUTIONS

- A. All substitutions must be submitted in accordance with Division 1 requirements.
- B. Substitutions submitted not in accordance with Division 1 requirements will be returned without review.
- C. All costs involved in changes in the building, to the equipment, to the arrangement of equipment, or to the work performed or to be performed under other sections of the specifications, due to the substitution of equipment in lieu of that shown on the drawings or specified, shall be borne by the Contractor making such substitutions, and shall include, but not necessarily be limited to, costs or fees in connection with resubmission of drawings for approval, if required, by the Commonwealth of Pennsylvania, local authorities or insuring agencies having jurisdiction over the work.

1.9 SUBMITTALS FOR CLOSEOUT

- A. Record Drawings: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, Subcontractor or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the mark-up before enclosing concealed installations.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.

- c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of cable tray and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Locations of concealed internal utilities.
 - i. Changes made by Change Order.
 - j. Changes made following Architect's written orders.
 - k. Details not on the original Contract Drawings.
 - l. Field records for variable and concealed conditions.
 - m. Record information on the Work that is shown only schematically.
- 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
 - 7. Provide one (1) hard copy and one (1) PDF electronic file on digital media acceptable to Architect/Engineer for Owner. Provide one (1) additional PDF electronic file for the Engineer.
- B. O&M Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
- 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Enable bookmarking of individual documents based upon file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel upon opening file.
 - 3. Provide two (2) copies of the PDF electronic files on digital media acceptable to Architect/Engineer. One copy shall be for the Owner and the other shall be for the Engineer.
- C. O&M Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
- 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 1-1/2 x 11" paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL", Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2 x 11" white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
6. Provide three (3) hard copies for Owner. Submit to Architect/Engineer for review and approval.

D. The Contractor shall submit 3 copies of the final wiring certificates.

E. The Contractor shall submit a copy of the Project Warranty

1.10 WARRANTY

A. The Contractor shall submit the following guarantee:

1. Written one (1) year full warranty guarantees shall be submitted for the entire electrical installation installed under this project (except lamps). The warranty shall begin at substantial completion of the project. If the manufacturer's warranty begins when the equipment ships or is ordered, then the Contractor shall extend the warranty to cover the construction period plus the warranty specified under substantial completion. If the manufacturer's standard guarantee provides for a longer period, the longer period shall apply.
2. Where defects in the material, equipment and/or workmanship become evident within this guarantee period, the Contractor shall be responsible for providing new manufacturer approved material and equipment, and/or correcting the defective workmanship without any costs to the Owner.

1.11 INSPECTION

- A. Inspections of electrical work will be made by an agency hired by the Contractor.
- B. Contractor shall pay all inspection fees and submit 3 copies of final wiring certificates to Architect.

1.12 VISIT TO THE SITE

- A. Prior to submission of bid, the Contractor is requested to visit the site to become acquainted with existing conditions. Bids as submitted will be interpreted to include all costs and changes made necessary by such conditions. Refer to the pre-bid meeting schedule in invitation to bid.

1.13 COORDINATION OF WORK

- A. Coordination and meetings: Coordinate the installation of all interior and exterior products and systems specified for this construction project including those specified under multiple prime contracts in accordance with Division 1.
- B. Coordination with Various Trades: Contractor shall coordinate space and installation requirements of all work, including underground utilities, which is indicated diagrammatically on drawings, with the project manager, respective

contractors and Utility Company's prior to starting any work. In case of interference or problems, the Architect shall decide which work is to be relocated, regardless of which work is installed first, at no additional cost. See Division 1 General Requirements.

1.14 UTILITY COMPANY CONTACTS & COORDINATION

- A. MET-ED: John Levengood - 717-821-1641
- B. Coordinate with each utility which serves the facility being constructed under this contract.
 - 1. Verify the utility company requirements indicated on Contract Drawings and in the Specifications and adjust as required.
 - 2. Notify the utility company of the date of completion of those portions of the work which are provided for utility company use.
 - 3. Make all other notifications requested by the utility.
 - 4. Provide equipment submittals as necessary for Utility review and approval.
- C. The Owner will pay all utility company service costs.
- D. Contractor to verify with the various Utility Company's exact location of their facilities and exact location for terminating the service conduits before starting any work and adjust as required.

1.15 LOCATION OF EQUIPMENT AND OUTLETS

- A. Request detailed and specific information regarding the locations of all equipment as the final location may differ from that indicated on the drawings.

1.16 MATERIAL QUALITY

- A. Use the best grade and quality items in commercial practice. Provide the manufacturer's name, address, and catalog number on a plate securely affixed in a convenient place. All electrical equipment or apparatus of any one system must be the product of one manufacturer, or equivalent products of a number of manufacturers, which are suitable for use in a unified system.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firms acceptable to the authority having jurisdiction.

1.17 WORKMANSHIP

- A. Execute all work utilizing qualified and competent employees and in a manner consistent with good workmanship. Install all equipment in accordance with Engineer's approved shop drawings and manufacturer's recommendations.
- B. Firmly support and secure to the building construction all materials and equipment. Use only approved hardware and methods as described in these Specifications.

1.18 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Responsibility for care and protection of electrical work rests with Contractor until it has been tested and accepted. Refer also to specific requirements in each section of this specification.

1.19 SCAFFOLDING AND HOISTING

- A. The Contractor shall furnish and erect all scaffolding, hoists, shoring, platforms, railings, ladders, and other devices required by local, state and federal laws to install all systems and equipment. Scaffolding and all other equipment shall be removed at completion of the work.
- B. Contractor shall hoist or rig his own material and equipment into place, or arrange for the rigging of it by others at his expense.

1.20 FOREMAN

- A. Contractor must provide a competent foreman, subject to approval of the Architect. The foreman shall be deemed the agent of the Contractor and must be on duty at the building during all working hours.
- B. Any instructions or notices given to the foreman shall have the same force as if given to the Contractor in person.

1.21 PAINTING

- A. All painting of electrical components and materials in finished area will be done under the general construction contract. If electrical components are installed after the area is painted, the Electrical Contractor shall be responsible to paint the electrical components.
- B. Factory painted and galvanized finishes which are damaged before the Owner occupies the building shall be repaired with matching paint or cold galvanizing compound respectively. Touch-up of factory finishes shall be done by the Electrical Contractor.

1.22 CUTTING AND PATCHING

- A. This Contractor shall be responsible for all cutting and patching required for installation of work on this project. Cutting and patching methods shall conform to the requirements for new construction contained in other sections of this specification.
 - 1. Patching in surfaces that will remain visible when the project is finished shall be identical in appearance to the undisturbed surface.
 - 2. Patches in fire rated walls, ceilings and floors shall maintain the fire rating of these barriers by the use of approved materials including special fire rated sealing compounds or materials identical to the barrier materials. Refer to the Architectural Specifications for approved methods and materials.
 - 3. Refer to Division 1 for additional requirements.

1.23 WORK SEQUENCE

- A. Refer to Architectural Drawings and Specifications for Phasing Requirements for this Project and the approved Contractors Phasing Schedule. This Contractor shall plan and coordinate his work in accordance with those requirements. Provide any and all temporary electrical lighting, power and system modifications to keep the occupied areas in service and maintained by the respective contractor.

1.24 CLEANING AND FINISHING

- A. After all tests have been made and the system proven satisfactory to the Architect, the Contractor shall go over the entire project, clean all equipment and material installed by him, and leave in a clean and working condition.

1.25 PERFORMANCE OF EQUIPMENT

- A. Provide materials, equipment, and appurtenances of any kind, shown on the drawings, hereinafter specified or required for the completion of the work in accordance with the intent of these specifications, which are completely satisfactory and acceptable in operation, performance, and capacity. Approval, either written or verbal, of any drawings, descriptive data or samples of such material, equipment, and/or appurtenance does not relieve the Contractor of his responsibility to turn over the same to the Owner in perfect working order at the completion of the work.
- B. Replace any materials, equipment, or appurtenances, the operation, capacity, or performance of which does not comply with the drawings and/or specification requirements or which is damaged prior to acceptance by the Owner with proper and acceptable items in working order, satisfactory to the Engineer and Architect without additional cost to the Owner.

1.26 ACCESS

- A. Furnish and erect all scaffolding and ladders required in the installation of wiring, equipment and fixtures.

1.27 ANCHOR BOLTS

- A. Provide and set in place, at the time of pouring of concrete foundations, all necessary anchor bolts as required for the equipment called for under these specifications. Provide anchor bolts of the hook type, of proper size and length to suit the equipment. The Contractor is responsible for proper emplacement of the bolts and must have representative present at the time foundations are poured.

1.28 INSERTS

- A. Where desired in cast in place concrete, provide and install inserts of an approved type. Where two or more parallel conduits are installed, continuous inserts may be used. Where required to distribute the load on the inserts, install a piece of reinforcing steel of sufficient length through the inserts.

1.29 SLEEVES

- A. Furnish to the General Contractor sleeves and locations where work of this contract must pass through new walls, floors, ceilings, roofs and other construction. Extend each sleeve through the floor, wall or partition and cut flush with each surface unless otherwise required.
- B. For sleeves in bearing and masonry walls, floors, and partitions provide standard weight steel pipe finished with smooth edges. For other than masonry partitions, through suspended ceilings, and for concealed vertical piping, provide No. 22 U.S.G. galvanized iron, unless otherwise specified.
- C. Where conduits pass through the roof provide pre-molded synthetic rubber flashing boots or other approved means approved by the Roofing Contractor. Install as per Roofing Contractor.

- D. Provide any sleeve or opening not installed or made during construction under the requirements for cutting and patching.
- E. Provide sleeves as required in existing walls for renovation projects.

1.30 FIRESTOPPING

- A. The Contractor shall be responsible for providing permanent, UL approved firestopping systems for all penetrations through fire rated floor or fire rated wall assemblies. For areas that will require future access for the installation of additional cables, repair, or retrofit, the firestopping system shall consist of re-usable intumescent pillows or putty. All firestopping shall meet the requirements of ASTM E-814 and UL 1479.
- B. Subject to compliance with project requirements, firestopping materials may be provided by one of the following manufacturers:
 - 1. Specified Technologies Inc. (STI) Somerville, NJ (800) 992-1180
 - 2. Tremco, Beechwood, OH (800) 321-7906
 - 3. 3M, St. Paul, MN (800) 328-1687
- C. Submit the following for review and approval:
 - 1. Product data sheets
 - 2. UL System drawings for each firestopping application
 - 3. Manufacturer's Certificates of Conformance for their products

1.31 ACCESS PANELS

- A. Provide panels with fire ratings equal to the surface in which they are installed and be 12" x 12" or 4" larger than each dimension of the enclosed box, whichever is greater.

1.32 TESTING, ADJUSTING AND BALANCING

- A. Make all connections at panels and switches; make all splices and taps. Install fuses in all fuse holders. Complete all circuits from power sources to loads at the time of final inspection.
- B. Upon completion of the work, test all parts of the electrical installation to ensure that it is free of unwanted grounds and other defects. Preliminary testing with continuity meters will be permitted, but will not be accepted in obtaining final results. Make final tests with a megger.
- C. Check load balance and rearrange connections so that the KW demand on each of the phase conductors does not vary by more than 10%.
- D. Set all overload devices, including equipment furnished under other contracts, and adjust to suit the load conditions. Make selections in accordance with NEC requirements and manufacturer's instructions.
- E. Ensure that all covers, closures, doors and plates are in place.
- F. Ensure that all trims and covers are adjusted to be parallel or perpendicular to building lines, tight against surrounding architectural finishes, and devices are set flush.
- G. Check devices and controls for proper mechanical and electrical operation and set to normal or appropriate positions at the time of contract closeout.

1.33 EXAMINATION OF CONTRACT DOCUMENTS

- A. Carefully examine the architectural, civil, structural, heat-ventilating - air conditioning, plumbing and sprinkler drawings. If any discrepancies occur between the drawings or between the drawings and the specifications, report such discrepancies to the Engineer and the Architect in writing in a Request For Information (RFI) form and obtain written instructions as to the manner in which to proceed. Make no departures from the contract drawings without prior written approval of the Architect/Engineer.
- B. Report any discrepancies prior to the submission of bid. In the event that such discrepancies are not reported and claims for extra charges to the contract result, such claims will be allocated to and paid for by the Contractor, who, in the opinion of the Engineer and the Architect, is the responsible party.

1.34 EQUIPMENT WIRING - GENERAL

- A. Unless otherwise mentioned herein or shown on the drawings, provide power wiring to all equipment, associated controls and appurtenances. Refer to Specifications Section 260180 for further information on equipment provided under the electrical and other contracts.

1.35 TEMPORARY FACILITIES

- A. Provide temporary electric and lighting as required by Division 01.

1.36 PLENUM WIRING

- A. This is an air "Plenum" project. Cabling installed in plenums or in areas above hung ceilings, used as a plenum, shall be plenum rated or installed in conduit.

1.37 SYSTEM WIRING METHODS

- A. Unless otherwise mentioned in the specific specification section, provide the low voltage system wiring methods listed below.
- B. Wire Routing: Route all device wiring from each device up into accessible ceiling cavity within metallic conduit in recessed or unfinished areas and within surface raceway for renovated non-fishable areas. Stub all conduits into accessible ceiling cavity and provide bushing for each.
- C. Cable Routing: Route cable for all device wiring within accessible ceiling cavities. Install cable supports at 4' spacing maximum or in cable tray where applicable. No cabling is to lie on or attach to ceiling tile, ducts, pipes, conduits or ceiling suspension wires, rods or structural members. Provide conduit stubs from devices and panels to the ceiling cavities. Use cable tray for support when it is shown on the drawings.
- D. Route all system wiring from system equipment within metallic conduit up into nearby ceiling cavity and connect to the wiring system indicated in A and B above. Provide bushings at conduit ends.
- E. Refer to individual sections for methods specific to that system.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 MOUNTING HEIGHTS AND LOCATION

- A. Outlets, controls and system components shall be mounted at the heights listed below unless otherwise indicated. Heights shall be measured to the centerline of the box from the finished floor unless otherwise noted.
 - 1. Wall Switches: 42"
 - 2. Receptacle Outlet (General): 1'-6" unless indicated otherwise
 - 3. Receptacle Outlet (Mechanical, Storage, Electrical, Unfinished Rooms): 42"
 - 4. Telephone Outlet: 1'-6" unless indicated otherwise
 - 5. Data Outlet: 1'-6" unless indicated otherwise
 - 6. Fire Alarm Devices: Refer to Fire Alarm Section.
 - 7. Receptacles above counters or benches with full height or no backsplashes: 0'-8" above countertop.
 - 8. Dryer Outlet: Verify location and mounting height with Architect before roughing-in.
 - 9. Water Cooler Outlet: Verify location and mounting height with Plumbing Contractor before roughing-in.
- B. Equipment shall be mounted as follows:
 - 1. Safety Switch 5'-0" to top of enclosure.
 - 2. Enclosed circuit breakers 5'-0" to top of enclosure.
 - 3. Enclosed Motor Controllers 5'-0" to top of enclosure.
 - 4. Enclosed Contactors: 5'-0" to top of enclosure.
 - 5. Time Controls: 5'-0" to top of enclosure.
 - 6. Combination Starters: 5'-6" - 6'-0" to top of enclosure.
 - 7. Panelboards 6'-6" to top of enclosure.
- C. When specifically detailed in the Architectural or Electrical drawings, mounting heights are to be as indicated. Consult architectural plans and elevations for individual areas where device locations may conflict with other work.
- D. In general, coordinate all device locations with approved Casework Drawings, Architectural Elevation and Drawings, Mechanical, Plumbing, approved Kitchen and Room Equipment Drawings and other applicable drawings.
- E. In lavatories or rooms with casework or fixed cabinets, coordinate mounting heights and locations in the field with architectural elevations and adjust as required to avoid conflicts with mirrors, back splashes, fixtures and hardware items.
- F. Field verify the final rough-in location for the actual equipment to be connected.
- G. Lighting Fixtures: As scheduled or indicated.

END OF SECTION 260010

SECTION 260180

EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical Connections to Equipment Specified under other Sections

1.2 RELATED WORK/DIVISIONS

- A. Division 1
- B. Division 8
- C. Division 10
- D. Division 11
- E. Division 12
- F. Division 14
- G. Division 23

1.3 REFERENCES

- A. NEMA WD 1 - General Purpose Wiring Devices.
- B. NEMA WD 6 - Wiring Device Configurations.
- C. ANSI/NFPA 70 - National Electrical Code.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.5 COORDINATION

- A. Coordinate work under provisions of Section 260010.
- B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

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- E. Sequence electrical connections to coordinate with start-up schedule for equipment.

1.6 ELECTRICAL EQUIPMENT BY OTHERS

- A. Provide all power and control wiring for products furnished and installed under contracts for Divisions 2 through 14. Switches, pushbuttons, indicator lights and control panels are supplied as part of the equipment package unless otherwise noted on the drawings.
- B. Provide power wiring for equipment as provided under the Mechanical (Heating-Ventilating-Air Conditioning) and Plumbing Contracts. Complete all electrical power connections through the disconnect and starter to motor or load terminals. Control wiring and overload protection for this equipment is the responsibility of the Mechanical or Plumbing Contractors. Provide disconnect means for all mechanical and plumbing equipment as follows:
- C. Provide disconnect means for all 3- phase equipment. Mount switch adjacent to motor or load terminals.
- D. Provide thermal overload switches for all single phase motors and single phase equipment. Mount the switch adjacent to the motor or load terminals.
- E. Check three phase equipment for proper rotation. Change rotation as required.
- F. Smoke Dampers:
 - 1. Provide a disconnect switch, enclosed contactor and fire alarm auxiliary relay for each smoke damper.
 - 2. Provide 2 #10 + 1 #10 gnd in ¾" conduit through the contactor and disconnect switch to damper motor from the nearest 120/208V panelboard.
 - 3. Provide fire alarm wiring between auxiliary relay and fire alarm panel.
 - 4. Auxiliary relay shall control the contactor as required.

1.7 DIVISION 23 POWER REQUIREMENTS

- A. Refer to Mechanical/Plumbing and Fire Protection Schedules on Drawings and Division 23 Specifications. For the power requirements which were the basis of design, confirm the actual power before ordering/installing, notify Architect/Engineer.

1.8 COORDINATION OF RESPONSIBILITIES

- A. Division of responsibility between Contractors shall be as indicated below.
- B. The respective contractor shall provide all items of material and equipment for the following:

		DIV 23	DIV 26
1.	Rooftop Air Conditioner (RTC)		
	a. Furnish and install unit	X	
	b. Starter	X	
	c. Fused disconnect switch fused per manufacturer /NEC		X
	d. Power wiring thru disconnect and starter to terminals		X
	e. Control wiring	X	
	g. Control power transformer at starter	X	

		DIV 23	DIV 26
2.	Electric Variable Air Volume Boxes (V)		
	a. Furnish and install unit	X	
	b. Local disconnect switch		X
	c. Power wiring thru starter and disconnect to terminals		X
	d. Control wiring	X	
	e. Tester/Overload Protection	X	

		DIV 23	DIV 26
3.	Electric Cabinet Heaters (ECH)		
	a. Furnish and install unit	X	
	b. Thermal Toggle Switch/Disconnect switch		X
	c. Power wiring thru disconnect to unit		X
	d. Control wiring	X	

		DIV 23	DIV 26
4.	Exhaust Fans (EF)		
	a. Furnish and install unit	X	
	b. Local Disconnect Switch/Thermal Toggle Switch	X	
	c. Power wiring thru wall switch, disconnect switch, starter to unit		X
	d. Control wiring	X	

		DIV 23	DIV 26
5.	Water Heaters		
	a. Furnish and install unit	X	
	b. Fused disconnect switch fused per manufacturer /NEC		X
	c. Power wiring thru disconnect to unit		X

- C. The respective contractor shall provide all items of material and equipment for the equipment listed in the matrix.
- D. Any material and equipment not listed in the matrix shall follow the following requirements:
 - 1. Starter/Controls by Division 23.
 - 2. Fused disconnect switch by Division 26.
 - 3. Additional items required by Division 23.

1.9 ROUGHING-IN REQUIREMENTS

- A. The Contractor shall provide complete roughing-in requirements, including conduit, power and control wiring and etc. For the following items furnished under Divisions 6, 8, 10, 11, 12 and 14, unless otherwise indicated on the drawings.
 - 1. Door Hardware
 - 2. Smoke Dampers
 - 3. Water Cooler
 - 4. Washer/Dryer
- B. The equipment supplier shall provide wiring (point to point) diagrams where the Electrical Contractor is to make final connections.
- C. Refer to approved shop drawings for roughing-in requirements.

- D. Provide power and interconnecting wiring to all equipment required by the Hardware Manufacturers. Doors shall operate as described in the notes of the Hardware Package.
- E. Contractor is responsible for damaged equipment if it has been connected without consulting the equipment suppliers point to point wiring diagrams.

PART 2 - PRODUCTS

2.1 CORDS AND PLUG SETS

- A. Refer to Section 260726

2.2 RACEWAY AND POWER CONDUCTORS

- A. Refer to Sections 260533 and 260519 as appropriate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.
- B. Verify that all motors rotate in the correct direction. Correct the connections for motors which do not.
- C. Verify that unit requirements match specified circuit sizes. Notify mechanical contractor and engineer of any discrepancies.

3.2 ELECTRICAL CONNECTIONS

- A. Provide electrical connections in accordance with equipment manufacturer's instructions.
- B. Provide conduit connections to equipment using liquidtight flexible metallic conduit. Use liquidtight flexible metallic conduit with watertight connectors in damp or wet locations.
- C. Provide wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide receptacle outlet where connection with attachment plug as indicated or required. Provide cord and cap where field-supplied attachment plug as indicated or required.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Install disconnect switches, controllers, control stations, and control devices as indicated or required.
- G. Modify equipment control wiring with terminal block jumpers as indicated or required.

- H. Provide interconnecting conduit and wiring between devices and equipment as indicated or required.
- I. Modify as required for the installation of lug adapters, crimp-on reducers and hardware, as necessary, to terminate conductors on equipment.

END OF SECTION 260180

SECTION 260519

ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conductors and Cables
- B. Metal Clad Cable
- C. Wiring Connectors and Connections

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NETA - ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association).

1.3 SUBMITTALS FOR REVIEW

- A. Submit a letter stating that all equipment is in compliance with the specifications.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.6 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper. Substitution of aluminum for conductors specified as copper is not permitted.
- C. Conductor sizes are based upon 75°C insulation temperature ratings. When the contractor furnishes equipment which is listed for use with conductors having temperature ratings of less than 75°C, he shall furnish conductors sized in accordance with the 60°C column of NEC Tables 310-16 or 310-17 and the appropriate conduit size.
- D. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions. Include wire and cable lengths within 10' of length shown.

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- E. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.7 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 POWER CONDUCTORS

- A. Description: Single conductor insulated wire.
- B. Conductor: Copper, 98% conductivity minimum.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI/NFPA 70; Type THHN/THWN or XHHW insulation for feeders and branch circuits.

2.2 METAL CLAD CABLE (See Wiring Methods, Paragraph 3.3 of this Section for Restrictions)

- A. Description: ANSI/NFPA 70, Type MC.
- B. Conductor: Copper
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 75°C.
- E. Insulation Material: Thermoplastic.
- F. Armor Material: Steel or Aluminum.
- G. Armor Design: Interlocked metal tape.
- H. Jacket: None

2.3 WIRING CONENCTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material and type and class for application and for service indicated.
- B. All wire connectors shall be manufactured in full compliance with UL 486A.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS

- A. Concealed Dry Interior Locations: Use only power conductors, type THHN/THWN or XHHW insulation, in raceway.
- B. Exposed Dry Interior Locations: Use only power conductors type THHN/THWN or XHHW insulation, in raceway.
- C. Above Accessible Ceilings:
 - 1. Home Runs: Use only power conductors, Type THHN/THWN or XHHW insulation, in raceway.
 - 2. In Corridors and for Circuits which extend to other rooms: Use only power conductors, type THHN/THWN or XHHW insulation in raceway.
 - 3. Branch Circuits which do not extend beyond the walls of the room: Use power conductors, type THHN/THWN or XHHW insulation in raceway or metal clad cable.
- D. Wet or Damp Interior Locations: Use only power conductors, type THHN/THWN or XHHW insulation, in raceway.
- E. Underground Installations: Use only power conductors, type XHHW in raceway.
- F. Exterior Locations: Use only power conductors, type THHN/THWN or XHHW insulation, in raceway.
- G. Wiring methods indicated on Drawings supersede the General Statements in this Section.
- H. MC cable is specifically prohibited to penetrate walls to other spaces, and also prohibited above corridor ceilings other than short (10' or less) connections from raceway junction boxes to light fixtures and equipment.
- I. Throughout new installation, all raceways and boxes shall be installed so that they are concealed in new construction. Any exceptions shall be approved by Architect before installation.
- J. In renovation projects, MC cable shall be used for existing fishable walls for new recessed devices and equipment. For larger than 30A circuits use flexible metal conduit (Greenfield) with the appropriate conductors.
- K. In underslab branch circuit raceways, there should be no less than one raceway extension installed from electrical device to an above accessible ceiling location terminated in a junction box per room. The intent of this requirement is to give future access to this raceway and circuits.

3.4 INSTALLATION

- A. Install products in accordance with manufacturers' instructions.
- B. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- C. Use stranded conductors for control circuits.
- D. Use conductor not smaller than 12 AWG for power and lighting circuits.
- E. Use conductor not smaller than 16 AWG for control circuits.

- F. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75' from the panelboard to the last outlet.
- G. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200' from the panelboard to the last outlet.
- H. Pull all conductors into raceway at same time.
- I. Use suitable wire pulling lubricant for all building wire.
- J. Protect exposed cable from damage.
- K. Support cables above accessible ceiling, using spring metal clips or metal or plastic cable ties to support cables from structure. Do not support cables from ceiling suspension system. Do not rest cable on ceiling panels.
- L. Modify as required for the installation of lug adapters, crimp on reducers and hardware, as necessary, to terminate conductors on equipment.
- M. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- N. Clean conductor surfaces before installing lugs and connectors.
- O. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- P. Use split bolt connectors for copper conductor splices and taps No. 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150% of insulation rating of conductor.
- Q. Use gutter taps for taps from parallel feeder cables.
- R. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- S. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- T. Cover ends of spare conductors with electrical tape.
- U. Conductor Splices: Keep to minimum.
 - 1. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
 - 2. Use splice and tap connectors that are compatible with conductor material.
- V. Voltage Drop: All feeders on the project have been sized to limit voltage drop to 2% or less. It shall be the Contractor's responsibility to size branch circuits as necessary, based on their actual lengths, to limit branch circuit voltage drop to 3% or less. This will limit the overall voltage drop at each outlet to the 5% maximum allowed by the National Electrical Code.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 260553.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.6 FIELD QUALITY CONTROL

- A. Perform field inspection and testing. Provide a written report of all test results to the Engineer.
- B. Inspect wire and cable for physical damage and proper connection. Replace all conductors and cables with damaged, insulation, sheaths, or jackets.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor. Provide a written report of all test results to the Engineer.

END OF SECTION 260519

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grounding Electrodes and Conductors
- B. Equipment Grounding Conductors
- C. Bonding
- D. Telecommunication Equipment Grounding
- E. Service Entrance Equipment Grounding

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NPFA 99 - Health Care Facilities.
- C. NETA-ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association)

1.3 GROUNDING ELECTRODE SYSTEM

- A. Metal underground water pipe if present.
- B. Metal frame of the building.
- C. Rod electrode.

1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms for equipment operation at 601 volts or higher, 25 ohms for equipment operating at 600 volts or less.

1.5 SUBMITTALS FOR REVIEW

- A. Submit a letter stating that all equipment is in compliance with the specifications.
- B. Test Report: Indicate overall resistance to ground.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Accurately record actual locations of grounding electrodes.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 ROD ELECTRODE

- A. Material: Copper-clad steel.
- B. Diameter: 3/4"
- C. Length: 10'

2.2 MECHANICAL CONNECTORS

- A. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS

- A. Material: Copper alloy or copper.

2.4 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: 2/0 AWG.
- C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

2.5 MAIN TELECOMMUNICATIONS GROUND BUS

- A. Material: 1/4" tinned copper busbar
- B. Size: 4"x12" min
- C. Mounting: Insulated stand-off
- D. Location: Service Entrance Telecommunications Backboard.

2.6 ADDITIONAL TELECOMMUNICATIONS GROUND BUS

- A. Material: ¼" tinned copper busbar.
- B. Size: As required.
- C. Mounting: Insulated stand-off
- D. Location: MDF Room

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

- A. Grounding counterpoise: Grounding counterpoise shall consist of three (3) ground rods spaced 8' minimum on center. Rods shall be installed with top of rod 12" below finished grade. Rods shall be interconnected with a #4/0 bare copper electrode with cadweld connections at each ground rod. Provide dedicated 2" conduit for #4/0 bare copper electrode conductor to switchgear ground bus. Locate grounding electrode in a grassy area as close to the building as possible.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. Metal Water Service Pipe: Provide insulated copper grounding conductor in 2" conduit from the electrical main service entrance equipment grounding bus to the main metal water service entrances to building. Connect ground bonding conductors to main metal water service pipes by grounding clamp connectors where a dielectric main water fitting is installed, connect ground bonding conductor to street side of fitting. Bond grounding conductor to conduit or sleeve at each end.
- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- F. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- G. Install Products in accordance with manufacturer's instructions.
- H. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- I. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing.

- J. Provide bonding to meet Regulatory Requirements.
- K. Provide a grounding bushing and equipment grounding conductor on the terminal end of metallic conduit systems where any of the following conditions occur:
 - 1. A conduit carrying circuit conductors protected by an overcurrent device rated 50 amps or larger is connected to a metallic enclosure by concentric knockouts or reducing washers.
 - 2. Concentric knockout rings or bridges are broken.
 - 3. The enclosure is non-metallic and does not have an integral grounding strap.
 - 4. Conduits stub up through floors and foundations into switchboards, transformers and other equipment without a metallic wall at the point of entrance.
- L. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus or bushing or terminal.

3.3 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding conductor Terminations: For #8 AWG and larger, use pressure-type grounding lugs. #10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- G. Moisture Protection. If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connections and seal against moisture penetration of insulation and cable.

- H. Main Telecommunications Ground Bus: Connect to the following:
 - 1. CATV entrance ground lug with #6 copper - green insulation.
 - 2. Telephone entrance protector with #6 copper - green insulation.
 - 3. Bond to metal water pipe with #6 copper - green insulation. (Provide 1" conduit where run is over 3' away.)
 - 4. Bond to building roof steel with #6 copper - green insulation. (Provide 1" conduit where run is over 3' away.)
 - 5. Ground counterpoise with #3/0 copper - green insulation in 1" conduit.
 - 6. Main service entrance equipment ground bus with #3/0 copper - in 1-1/4" conduit.
 - 7. MDF rack ground bus with #3/0 copper - (provide in 1-1/4" conduit when not in cable tray).
- I. MDF Rack Ground Bus shall connect to the following:
 - 1. Each IDF in the project with #1/0 copper - green insulation via cable tray and 1-1/4" conduit. Bond to cable tray near IDF and MDF Racks.
 - 2. Bond to rack with #6 copper - green insulation.
 - 3. Building structural steel with #6 copper - green insulation.
- J. Identification: Provide tag on each ground conductor at bus to read as follows: "Caution - Ground Wire - Do not Remove". Provide I.D. marking of all conductors as per N.E.C.

3.4 FIELD QUALITY CONTROL

- A. Perform NETA-ATS testing and inspection of the grounding and bonding system.
- B. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- C. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall- of-potential method. Provide a report of the results of the test of each grounding system. Where several grounding systems are tied together, test each system separately before making the interconnection.

END OF SECTION 260526

SECTION 260529

HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and Equipment Supports
- B. Anchors and Fasteners
- C. Cable Supports

1.2 REFERENCES

- A. NECA - National Electrical Contractors Association.
- B. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW

- A. Submit a letter stating that all equipment is in compliance with the specifications.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.5 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is installer's option.

2.2 ANCHORS

- A. Provide anchors of types, sizes and materials indicated, with the following construction features:
 - 1. Toggle Bolts: Springhead; 3/16" x 4".
 - 2. Expansion sleeve anchors by Hilti or Phillips Redhead: 2"

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2.3 SLEEVES AND SEALS

- A. Provide sleeves and seals, of types, sizes and materials indicated, with the following construction features:
 - 1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
 - 2. Fire-Rated Walls and Floors: At all locations where conduits or cables penetrate a fire-rated wall or floor, provide firestopping in accordance with Division 7.

2.4 U-CHANNEL STRUT SYSTEMS

- A. Provide U-Channel strut system for supporting equipment supplied under this contract, 12-ga hot-dip galvanized steel, or types and sizes indicated with standard green finish, and with the fittings which mate and match with U-Channel.
- B. Auxiliary Steel Supports: Provide all required auxiliary steel to install any equipment supplied under this contract. The design and gauge of steel used shall be as required by the manufacturer's specifications.

2.5 NON-CONTINUOUS CABLE SUPPORTS (J-HOOKS)

- A. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high performance cables.
- B. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
- C. Non-continuous cable supports 1-15/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger.
- D. Non-continuous cable supports shall have an electro-galvanized finish and be rated for indoor use in non-corrosive environments.
- E. Non-continuous cable supports shall be UL listed, with manufacturer's name and part number stamped on.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure as required. Do not use spring steel clips and clamps.
- D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

- E. Do not fasten supports to piping, ductwork, mechanical equipment, and conduit.
- F. Do not use powder-actuated anchors.
- G. Obtain permission from Architect before drilling or cutting structural members.
- H. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present neat appearance with adequate strength and rigidity. Use hexagon head bolts with spring lock washers under all nuts.
- I. Install surface-mounted cabinets, enclosures and panelboards with minimum of four anchors.
- J. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1" off wall.
- K. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- L. Square cut and deburr all structural steel, strut, threaded rods and similar items.
- M. Prime and paint all ferrous metals which are not factory finished.
- N. Strut and Hardware Finishes:
 - 1. Indoor dry locations: painted or pre-galvanized.
 - 2. Outdoor and indoor wet locations: post-galvanized.
 - 3. Corrosive locations: PVC coated or fiber reinforced plastic.
 - 4. Water and Waste Water Treatment Facilities: aluminum or stainless steel.
- O. Coordinate with other mechanical, plumbing, sprinkler and electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- P. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports in compliance with NEC requirements.
- Q. Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form watertight seal.
- R. Remove burrs from ends of pipe sleeves.
- S. Do not use bridle rings or tie-wraps to support cables. J-hooks are the only acceptable support method.

END OF SECTION 260529

SECTION 260533

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal Conduit
- B. Flexible Metal Conduit
- C. Liquidtight Flexible Metal Conduit
- D. Electrical Metallic Tubing
- E. Nonmetallic Conduit
- F. Fittings and Conduit Bodies
- G. Wireways
- H. Boxes
- I. Cabinets
- J. Enclosures

1.2 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- C. ANSI C80.6 - Intermediate Metal Conduit, Zinc Coated.
- D. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- E. ANSI/NFPA 70 - National Electrical Code.
- F. NECA "Standard of Installation"
- G. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- H. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
- I. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- J. NEMA TC 12 - Corrugated Polyvinyl Chloride Coilable Plastic Utilities Duct.
- K. UL 94 - Vertical Flame Test
- L. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- M. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

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N. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes.

O. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70.

1.4 QUALITY ASSURANCE

A. Fire rated pathways shall bear the UL Classification marking.

B. Pathways shall be tested in accordance with ASTM E814 (ANSI/UL1479)

1.5 SUBMITTALS FOR REVIEW

A. Submit a letter stating that all equipment is in compliance with the specifications.

1.6 SUBMITTALS FOR CLOSEOUT

A. Submit under provisions of Section 260010.

B. Accurately record actual routing of conduits larger than 1" which are installed underground or under a slab on grade.

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle Products to site under provisions of Section 260010.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect non-metallic conduit from sunlight.

1.9 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

1.10 WARRANTY

- A. Provide the warranty specified in section 260010.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

- A. Minimum Size: 3/4" unless otherwise specified.
- B. Where control devices are provided with 1/2" knockouts or hubs, 3/8" or 1/2" flexible conduit not exceeding 3' in length may be installed between the device and a junction box or conduit fitting.
- C. Underground Installations: Use galvanized rigid steel conduit or nonmetallic conduit as indicated.
 - 1. Minimum Size: 1"
- D. Outdoor Locations, Above Grade: Use galvanized rigid steel conduit or intermediate metal conduit.
- E. Outdoor Locations, Below Grade: Use nonmetallic conduit, concrete encased or stonedust encased per details on drawings. All elbows shall be long radius steel.
- F. Wet and Damp Locations: Use galvanized rigid steel or intermediate metal conduit.
- G. Dry Locations:
 - 1. Concealed: Use galvanized rigid steel, intermediate metal conduit or electrical metallic tubing.
 - 2. Exposed: Use galvanized rigid steel, intermediate metal conduit or electrical metallic tubing.

2.2 METAL CONDUIT

- A. Galvanized Rigid Steel Conduit (GRC): ANSI C80.1.
- B. Intermediate Metal Conduit (IMC): Rigid steel.
- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit.

2.3 FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction.
- B. Fittings: ANSI/NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction with PVC jacket.
- B. Fittings: ANSI/NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: ANSI C80.3; galvanized tubing.

- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, compression type. Indenter type may be substituted for 3/4" size tubing installed in dry locations.

2.6 NONMETALLIC CONDUIT

- A. Description: NEMA TC 2; Schedule 40 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.7 WIREWAY

- A. Description:
 - 1. Indoor Use: General Purpose
 - 2. Where Indicated: Oil-tight and Dust-tight
 - 3. Outdoor Use: Rain-tight
- B. Knockouts: Manufacturer's Standard
- C. Size: Size and length as indicated or required for installation.
- D. Cover: Hinged or screw covers. Provide full gasketing on oil-tight wireways.
- E. Connector: Slip-in or flanged.
- F. Fittings: Lay-in type with removable top, bottom and sides.
- G. Finish: Rust inhibiting primer coating with gray enamel finish or pre-galvanized.

2.8 FIRE RATED PATHWAYS

- A. Manufacturers:
 - 1. Specified Technologies Inc.
 - a. EZ-PATH Fire Rated Pathway (single, double and triple)
- B. Pathways:
 - 1. Cables passing through fire-rated floors or walls shall pass through fire-rated wiring devices which contain an intumescent insert material that adjusts automatically to cable additions or subtractions.
 - 2. The device shall have an F rating equal to the rating of the barrier in which the device is installed.
 - 3. Wiring devices shall be capable of allowing a 0 to 100-percent visual fill of cables.
 - 4. Wire devices shall be of a sufficient size to accommodate the quantity and size of electrical wires and data cables required.
 - 5. Wire devices to be provided with steel wall plates allowing for single or multiple devices to be ganged together.

2.9 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Shape and size shall suit the type of fixture or canopy and be rated for weight of equipment supported; include 1/2" male fixture studs where required.
 - 2. Minimum Depth - 2-1/8"
 - 3. Concrete Ceiling Boxes: Concrete type.
 - 4. Provide 4" square boxes for fire alarm signaling devices and similar devices.

- B. Nonmetallic Outlet Boxes: NEMA OS 2.
- C. Cast Boxes: NEMA FB 1, Type FD, aluminum or cast ferrous alloy. Provide gasketed cover by box manufacturer. Provide boxes with threaded hubs.
- D. Use cast outlet boxes in exterior and wet locations.

2.10 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
 - 1. Cover: Furnish with machine screws.
- B. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron or Cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

2.11 HINGED COVER ENCLOSURES

- A. Manufacturers:
 - 1. Square D
 - 2. Hoffman Engineering
 - 3. Hammond Manufacturing
- B. Construction: NEMA 250, galvanized steel.
- C. Covers: Continuous hinge, held closed by perimeter clamps operated by screws.
- D. Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
- E. Enclosure Finish: Manufacturer's standard enamel.
- F. Provide accessory feet for free standing enclosures.
- G. Enclosure:
 - 1. Interior Dry Locations: Type 1
 - 2. Interior Wet Locations: Type 4
 - 3. Exterior Locations: Type 3R
 - 4. Kitchen: Stainless Steel
 - 5. Dishwashing Rooms/Areas: Stainless Steel

2.12 CABINETS

- A. Manufacturers:
 - 1. Square D Company
 - 2. Hoffman Engineering
 - 3. Hennesy Enclosures
- B. Boxes: Galvanized Steel
- C. Box Size: As indicated or as required to house the indicated quantity of cables and connections plus 20% spare.
- D. Backboard: Provide $\frac{3}{4}$ " thick plywood backboard for mounting terminal blocks. Paint matte white.

- E. Fronts: Steel, flush or surface type as indicated with concealed trim clamps, concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- F. Knockouts: As required.
- G. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.
- H. Provide accessory feet for free standing equipment.
- I. Enclosure:
 - 1. Interior Dry Locations: Type 1
 - 2. Interior Wet Locations: Type 4
 - 3. Exterior Locations: Type 3R
 - 4. Kitchen: Stainless Steel
 - 5. Dishwashing Rooms/Areas: Stainless Steel

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify locations of floor boxes and outlets prior to rough-in.

3.2 INSTALLATION

- A. Install conduit in accordance with NECA "Standard of Installation" except paragraphs on "Mounting Height".
- B. Install nonmetallic conduit in accordance with manufacturer's instructions.
- C. Arrange supports to prevent misalignment during wiring installation.
- D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- E. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25% additional conduits.
- F. Fasten conduit supports to building structure and surfaces under provisions of Section 260010.
- G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports
- H. Do not attach conduit to suspended ceiling support wires.
- I. Arrange conduit to maintain headroom and present neat appearance.
- J. Route conduit parallel and perpendicular to walls.
- K. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- L. Route conduit in stone/gravel fill under slab from point-to-point.
- M. Maintain adequate clearance between conduit and piping.

- N. Maintain 12" clearance between conduit and surfaces with temperatures exceeding 104°F.
- O. Cut conduit square using saw or pipe-cutter; de-burr cut ends.
- P. Bring conduit to shoulder of fittings; fasten securely.
- Q. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- R. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- S. Install no more than equivalent of three 90° bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2" size.
- T. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- U. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.
- V. Provide suitable pull string in each empty conduit except sleeves and nipples.
- W. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- X. Ground and bond conduit and wireways under provisions of Section 260526.
- Y. Identify conduit under provisions of Section 260553.
- Z. Do not install conduits in the topping on precast floor and roof planks and tees.
- AA. Wireway Supports: provide steel channel supports as required or indicated. Mount directly on suitable walls and structural elements.
- BB. Close ends of wireway.
- CC. Install fire rated pathways in strict accordance with the approved shop drawings and the equipment manufacturer's recommendations.
- DD. Apply the factory supplied gasketing material prior to the installation of the wall plates for the fire rated pathways.
- EE. Secure wall plates to devices per the equipment manufacturer's recommendations for the fire rated pathways.
- FF. Install in accordance with manufacturer's instructions.
- GG. Install boxes in accordance with NECA "Standard of Installation" except for mounting heights.
- HH. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

- II. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- JJ. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10' if required to accommodate intended purpose.
- KK. Orient boxes to accommodate wiring devices oriented as specified in Section 262726.
- LL. Maintain headroom and present neat mechanical appearance.
- MM. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- NN. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6" from ceiling access panel or from removable recessed luminaire.
- OO. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 7.
- PP. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes and beside lavatory partitions, mirrors, lavatory fixtures and changes in architectural finishes.
- QQ. Locate outlet boxes to allow luminaries positioned as shown on reflected ceiling plan.
- RR. Align adjacent wall mounted outlet boxes which are indicated to be mounted at the same height.
- SS. Use flush mounting outlet box in finished areas.
- TT. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening. Provide minimum 24" separation or as required by code in fire rated walls.
- UU. Do not install flush mounting box back-to-back in walls; provide minimum 6" separation. Provide minimum 24" separation in acoustic rated walls.
- VV. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- WW. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- XX. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- YY. Use adjustable steel channel fasteners for hung ceiling outlet box.
- ZZ. Do not fasten boxes to ceiling support wires.
- AAA. Support boxes independently of conduit.
- BBB. Use gang box where more than one device is mounted together. Do not use sectional box.
- CCC. Use gang box with plaster ring for single device outlets.
- DDD. Use cast outlet box in exterior locations and wet locations.

- EEE. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.
- FFF. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
- GGG. Install cabinet fronts plumb.
- HHH. Do not drill or punch cabinets and enclosures except where devices or hardware which have the same NEMA type rating are being installed.
- III. Mount waterproof enclosures using the holes or brackets furnished by the manufacturer only.
- JJJ. Provide enclosures for all control devices, pilot devices, timers, starters, contactors, adjustable frequency drives and programmable logic controller.
- KKK. Provide cabinets where indicated or as required.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.
- B. Route conduit through roof, wall, floor and ceiling openings and repair as specified in Section 260010.
- C. Indoor Dry Type Transformers: Provide flexible conduits not exceeding 3' in length between the transformer enclosure and the end of all rigid conduits and non-flexible tubing. The flexible conduit shall be installed with a minimum 45° bend in its length.
- D. Motors: Provide flexible conduit not exceeding 4' in length between the motor junction box and the end of all rigid conduits and non-flexible tubings. Provide sufficient slack to permit the motor to be moved over the entire range of adjustment in the motor base and sub-base without stressing the flexible conduit or its connectors.
- E. Other Adjustable Devices: Provide flexible conduit at any device which has electrical connections and is adjusted for proper operation by sliding or rotating the mounting of the device. Provide flexible conduit of sufficient length to permit the full range of adjustment allowed by the device mounting.
- F. Prewired Furniture: provide liquidtight metal conduit not exceeding 4' in length between floor/wall box and furniture connection point for power and telecommunications.
- G. At HVAC equipment on trapeze hangers or vibration isolators, provide sufficient length of flexible conduit to accommodate the full range of normal motion without stressing the conduit or transmitting excessive mechanical forces to rigidly mounted conduit or building structures. Install the flexible conduit in such a manner that a 90° bend is included in the length of flexible conduit.
- H. Provide flexible conduits that are of sufficient length so they allow the full range of movement for adjustment and vibration without stressing the flexible conduit or connectors.
- I. Coordinate installation of outlet box for equipment connected under Section 260180.

3.4 INTERFACE WITH CONCRETE SLABS

- A. Conduits are not permitted in concrete slabs or elevated slabs for this project.
- B. Concrete Floors on Grade: Install conduits under concrete slabs in stone base.
- C. Concrete Elevated Floors: Install conduits below slab in ceiling plenum of floor below.
- D. Review all underslab conduit interface with Architect/Engineer before installation.

3.5 ADJUSTING

- A. Test, adjust and balance as required.
- B. Adjust floor box flush with finish flooring material.
- C. Adjust flush-mounting outlets to make front flush with finished wall material.
- D. Install knockout closures in unused box openings.

3.6 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION 260533

SECTION 260583

UTILITY SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Arrangement with Utility Company for permanent electric service.
- B. Service entrance as indicated on the drawings.
- C. Metering equipment.

1.2 COORDINATION

- A. The Contractor shall provide the following items in accordance with the serving electric utility company's requirements:
 - 1. Service Disconnecting Device
 - 2. Service Lug Compartments and Lugs
 - 3. Instrument Transformer Compartments or Enclosures
 - 4. Meter Sockets
 - 5. Service Trenches
 - 6. Transformer Foundations and Grounding
 - 7. Service Conduits and Ductbanks
 - 8. Service Conductors and Terminations
 - 9. Riser Conduits, Elbows and Stand-offs
- B. Refer to Section 260010 of this specification, who is responsible for all service costs.
- C. Contractor to verify with the various Utility Company's exact location of their facilities and exact location for terminating the service conduits before starting any work and adjust as required.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.4 SYSTEM DESCRIPTION

- A. Utility Company: MET-ED
- B. System Characteristics: As indicated on the drawings.
- C. Service Entrance: As indicated on the drawings.

1.5 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal Booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.

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1.6 QUALITY ASSURANCE

- A. Perform work in accordance with Utility Company written requirements.
- B. Maintain one copy of each document on site.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.8 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated.

PART 2 - PRODUCTS

2.1 UTILITY METERS

- A. Meters will be furnished by Utility Company.

2.2 UTILITY METER BASE

- A. Meter base will be provided by the Contractor.

2.3 METERING TRANSFORMER CABINET

- A. Manufacturers:
 - 1. Provided by Contractor per Utility Company approval list when applicable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions under provisions of Section 260010.
- B. Verify that service equipment is ready to be connected and energized.

3.2 PREPARATION

- A. Make arrangements with Utility Company to obtain permanent electric service to the Project.
- B. Coordinate location of Utility Company's facilities to ensure proper access is available.

3.3 INSTALLATION

- A. Install service entrance conduits in concrete envelope from Utility Company's terminal pole to building service entrance equipment. Utility Company will connect secondary service lateral conductors to pole mount transformers.

- B. The Contractor shall furnish and install, via the underground ducts, the secondary service conductors from the pole mount transformers to the building service equipment and make final connections at the service entrance equipment.

END OF SECTION 260583

SECTION 260923

LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Time Controls
- B. Photoelectric Relays

1.2 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed in the system.
 - c. Data sheets of all items to be provided with the specific item or model number highlighted.

1.3 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record actual locations of dimmer outlets and circuiting arrangements in project record documents.
- C. Operation Data:
 - 1. Instructions for operating lighting control system.
 - 2. Instructions for operating system under unusual conditions when emergency life safety conditions exist.
 - 3. Operating limits which may result in hazardous or unsafe conditions, or in equipment damage.
 - 4. Document ratings of system and of each major component.
- D. Maintenance Data:
 - 1. Routine preventive maintenance schedule.
 - 2. Lists of special tools, maintenance materials, and replacement parts.
 - 3. Repair instructions for procedures to check, repair, and test equipment during typical malfunctions.
 - 4. Recommended cleaning methods, frequency, and materials.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Supplier: Authorized or Franchised distributor of specified manufacturer with minimum three years documented experience.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.

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- B. Products: Listed and classified by Underwriters Laboratories, Inc. or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 TIME CONTROLS

- A. Electric photo initiated.
- B. Manufacturers:
 - 1. Intermatic ET8000CR Series
 - 2. Tork
 - 3. Paragon
- C. Scheduling Capability:
 - 1. The electronic time switch shall be a solid state digital type capable of distributing setpoints on independent daily schedules throughout a 7 day time period. The time switch shall provide for a 5 weekday programming, 2 weekend day programming or all 7 day programming to simplify program entry for typical 5/2 day load control. A copy feature shall be provided for duplicating full daily schedules where the 5/2 day scheduling is not applicable. The time and setpoints shall be programmable to the nearest minute with a minimum ON duration of 1 minute and a maximum of 6 days, 23 hours and 59 minutes. The time switch shall have a digital LED readout and prompt LEDs for each function to further simplify program entry. Each load control shall include an ON/OFF pushbutton, an ENABLE/DISABLE switch and an LED load status indicator. The time switch shall provide an operating temperature range of -40°F (-40°C) to 122°F (50°C).
 - 2. The time switch shall provide astronomic programming and momentary or interval programming for any or all circuits independently. Astronomic control shall automatically calculate "center of time zone" times for both sunrise and sunset, and allow user-selectable offset of actual times. Pulse output shall be programmable for any duration of 1-127 seconds and interval output for up to 6 days, 23 hours and 59 minutes. Interval output shall also provide for user selectable override to turn load(s) on for a limited programmed time period up to 6 days, 23 hours and 59 minutes. See additional specifications to follow.
- D. Automatic Adjustment: The time switch shall provide full year control by providing automatic leap year and daylight saving time adjustment. A user selectable override shall be provided for states not observing daylight saving time. The time switch shall also provide holiday or special day control requirements by providing up to 99 holiday schedules. Each of the holiday schedules shall be programmable for a single day or any duration as required. Each holiday schedule shall provide automatic no load activity and shall be independently programmable for a unique load schedule if required.
- E. Memory: A non-volatile memory shall maintain all program data for the life of the time switch without the need for battery backup. The time switch shall include a factory installed lithium battery backup which shall maintain clock time and calendar data for 8 years minimum. The single coil cell backup shall be user replaceable without removing the field wiring.
- F. Protection: The time switch logic control circuitry shall be isolated and shielded to prevent EMI and RFI interference, for reliable operation in

electrically noisy environments. The power board circuitry shall provide protection for transients up to 6,000 volts. All control times shall be accurate to the minute and synchronized to the 50 to 60 Hz input. The time switch shall provide user-selectable 12 hour AM/PM or 24 hour clock formats.

- G. Enclosure: The time switch shall be enclosed in a lockable steel NEMA 1 enclosure. The time switch shall be powered by 120 or 60 Hz source.
- H. Contacts: Switch configuration to be SPDT for each circuit with a UL 916 Energy Management Equipment listed rating of:
 - 1. Normally Open Contacts: 470 VA pilot duty, 12-240 VAC
 - 2. Normally Closed Contacts: 276 VA pilot duty, 12-240 VAC
- I. Output Channels: As required plus 20% spare (8 min).
- J. Accessories: Provide relay for photo initiation of ON period on all channels.

2.2 PHOTOELECTRIC RELAYS

- A. Manufacturers:
 - 1. Intermatic
 - 2. Tork
 - 3. Paragon
 - 4. Allen-Bradley Co., Inc.
- B. Conform to UL 773A
- C. Type: Solid-stage, with SPDT dry contacts rated to operate relay or contactor coils to which connected.
- D. Time delay prevents false operation.
- E. Outdoor Sealed Units: Weathertight housing, resistant to high temperatures and equipped with sun-glare shield and ice preventer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surface is suitable for time controls and photo electric relay.

3.2 INSTALLATION

- A. Install time controls where indicated, in accordance with manufacturer's instructions.
- B. Install time controls plumb. Provide supports in accordance with Section 260190.
- C. Refer to Section 260010 for mounting heights.
- D. Mount photocell for time control on north face of the roof. Adjust sensitivity as directed by manufacturer.
- E. Connect photocell to time control with 3 #12 in ¾" conduit unless otherwise directed by manufacturer.
- F. Provide engraved plastic nameplates under the provisions of Section 260195.

3.3 FIELD QUALITY CONTROL

- A. Perform inspection and testing.
- B. Verify settings of photoelectric devices with photometer calibrated to National Institute for Science and Technology (NIST) within the past 6 months.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems as required.

3.5 ADJUSTING

- A. Adjust installed work as required.

3.6 CLEANING

- A. Clean installed work as required.
- B. Clean electrical parts to remove conductive and harmful materials.
- C. Remove dirt and debris from enclosure.

3.7 DEMONSTRATION

- A. Provide systems demonstration as required.
- B. Demonstrate operation of time controls and photoelectric relay.

3.8 TRAINING

- A. Personnel Training: Provide and pay for the services of a factory-authorized service representative to demonstrate the system and train Owners personnel.
 - 1. Provide training for operating, testing, troubleshooting and general maintenance of the system.
 - 2. Provide a minimum of one, 1 hour session.
 - 3. Provide documentation of sessions to Architect/Engineer with signatures of at least 3 Owners Representatives present at demonstration.

END OF SECTION 260923

SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Distribution Panelboards
- B. Branch Circuit Panelboards
- C. Integral Equipment

1.2 REFERENCES

- A. NEMA PB 1 - Panelboards
- B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- C. NEMA AB 1 - Molded Case Circuit Breakers
- D. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- E. UL 50 - Enclosures for Electrical Equipment
- F. UL 67 - Panelboards
- G. UL 98 - Enclosed and Dead-Front Switches
- H. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- I. CSA Standard C22.2 #29-M1989 - Panelboards and Enclosed Panelboards
- J. CSA Standard C22.2 #5-M91 - Molded Case Circuit Breakers
- K. Federal Specification W-P-115C - Type 1, Class 1
- L. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit and Service
- M. NFPA 70 - National Electrical Code (NEC)
- N. ASTM - American Society of Testing Materials

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.

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- c. Data sheets to indicate voltage, main bus ampacity, circuit breakers, short circuit rating with specific items or model numbers highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record actual locations of Products; indicate actual branch circuit arrangement.
- C. Contractor to submit a copy of all panelboard directory schedules to the Owner, showing correct room name and/or number, for his approval. Contractor to make changes recommended by the Owner before final typed directories are installed in panelboards.
- D. Submit record copy of all testing performed.
- E. Provide a copy of approved Panel Directory Schedules to be included in O&M Manuals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing of panelboards specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.
- C. Provide UL service entrance equipment on all units used as service entrance equipment.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Inspect and report concealed damage to carrier within their required time period.
- B. Handle carefully to avoid damage to panelboard internal components, enclosure and finish.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris and traffic.

1.8 MAINTENANCE MATERIALS

- A. Provide two keys for each panelboard installed.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D Company
- B. Eaton (Cutler Hammer / Westinghouse)
- C. Siemens Energy and Automation

2.2 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Ground Bus: Provide copper ground bus in enclosures and bond the bus to the enclosure.
- B. Neutral Bus: Provide insulated neutral bus in all enclosures where the feeder circuit contains a neutral conductor. Bond the neutral bus to the ground bus or enclosure when the enclosure contains the service main disconnect or the disconnect at a building which receives its power from a service in another building. Provide bus with current carrying capacity of 100% except where otherwise indicated.
- C. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- D. Ground Fault Systems: Provide ground fault systems and on-site testing per NEC Article 230 for panelboards with main service disconnect switch.
- E. Handle Locks:
 - 1. Provide accessories which permit circuit breaker handles to be pad-locked in the OFF position where indicated for indicated circuit breakers.
 - 2. Provide accessories which prevent circuit breaker handles from being manually moved from the OFF position for the handles of all circuit breaker which feed emergency lighting circuits, public address and intercom systems and uninterruptable power supplies.
- F. Load Side Terminations: Provide lugs on circuit breakers of sufficient size to terminate conductors scheduled or indicated on plans.
- G. Use only Owner-assigned room numbers in final panel directory card.
- H. For recessed double panels, allow at least 4" between backboxes so that trim does not butt or overlap.
- I. For surface mounted panelboards, provide top and bottom skirts when panelboards are located in areas other than mechanical rooms. Skirts to be same gauge and finish as panelboard and equipped with mounting flanges.
- J. Provide nameplates and labels as called for in Section 260553.
- K. Provide 2 - 100% neutral assemblies in all split bus panelboards.
- L. Provide "Hinged Trim" panelboard covers for all lighting and power panelboards. The entire trim shall be hinged to swing to one side of the box to access the panel gutter space.

2.3 PANELBOARD SHORT CIRCUIT RATING

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.
- B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, circuit breaker type suitable for use as service entrance equipment.
- B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- C. Minimum Integrated Short Circuit Rating:
 - 1. Amperes Interrupting Current (AIC) Ratings: 120V, 208V, and 240V breaker - minimum AIC 10,000 amps unless otherwise noted on the Drawings or Specifications.
 - 2. Amperes Interrupting Current (AIC) Ratings: 277V and 480V breaker - minimum AIC 18,000 amps unless otherwise noted on the Drawings or Specifications.
 - 3. The Contractor shall verify the AIC of panelboards with the fault current study and adjust as required to comply with the study.
- D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with a common trip handle for each pole. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Provide circuit breakers UL listed as Type HACR for heating, air conditioning and refrigeration equipment branch circuits.
- E. Provide circuit breaker accessory trip units and auxiliary switches as indicated.
- F. Enclosure: NEMA PB 1
 - 1. Interior Locations: Type 1
 - 2. Exterior Locations: Type 3R
- G. Cabinet Front:
 - 1. Front shall meet strength and rigidity requirements per UL 50 Standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - 2. Front shall be hinged 1-piece with door. Mounting shall be flush or surface as indicated.
 - 3. Panelboards shall have MONO-FLAT fronts with concealed door hinges and mounted with trim screws. Front shall not be removable with the door locked. Doors on front shall have rounded corners and edges shall be free of burrs.
 - 4. Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.

2.5 BRANCH CIRCUIT PANELBOARDS

- A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB1, circuit breaker type.

- B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- C. Minimum Integrated Short Circuit Rating:
 - 1. Amperes Interrupting Current (AIC) Ratings: 120V, 208V, and 240V breaker - minimum AIC 10,000 amps unless otherwise noted on the Drawings or Specifications.
 - 2. Amperes Interrupting Current (AIC) Ratings: 277V and 480V breaker - minimum AIC 18,000 amps unless otherwise noted on the Drawings or Specifications.
 - 3. The Contractor shall verify the AIC of panelboards with the fault current study and adjust as required to comply with the study.
- D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Provide circuit breakers UL listed as type HACR for heating, air conditioning and refrigeration equipment branch circuits. Do not use tandem circuit breakers.
- E. Enclosure: NEMA PB 1
 - 1. Interior Locations: Type 1
 - 2. Exterior Locations: Type 3R
- F. Cabinet Front:
 - 1. Front shall meet strength and rigidity requirements per UL 50 Standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - 2. Front shall be hinged 1-piece with door. Mounting shall be flush or surface as indicated.
 - 3. Panelboards shall have MONO-FLAT fronts with concealed door hinges and mounted with trim screws. Front shall not be removable with the door locked. Doors on front shall have rounded corners and edges shall be free of burrs.
 - 4. Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.

2.6 INTEGRATED SURGE SUPPRESSION DEVICE (SPD) PANELBOARDS

- A. Integral Surge Suppressor:
 - 1. SPD shall be component recognized in accordance with UL 1449 Third Edition to include Section 37.3 highest fault current category. SPD shall be UL 1283 listed. SPD shall be installed by and shipped from the electrical distribution equipment manufacturer's factory.
 - 2. The surge protection devices shall be bus mounted between the main and branch devices. Surge protection devices bussed off the end of the panelboard are not allowed. Panelboards with SPDs will accommodate thru-feed lugs and sub-feed circuit breakers in single section and multi-section panelboards.
 - 3. SPD shall provide surge current diversion paths for all modes of protection; L-N, L-G, N-G in WYE Systems.
 - 4. SPD shall be modular in design. Each mode including N-G shall be fused with a 200k AIR UL recognized surge rated fuse and incorporate a thermal cutout device.
 - 5. Audible diagnostic monitoring shall be by way of audible alarm. This alarm shall activate upon a fault condition. An alarm on/off switch shall be provided to silence the alarm. An alarm push to test switch shall be provided.
 - 6. SPD shall have a minimum EMI/RFI filtering of -30dB at 100 kHz with an insertion ratio of 50:1 using MIL-STD-220A methodology.

7. SPD shall be provided with one set of NO/NC dry contacts.
 8. SPD shall have a warranty for a period of 10 years, incorporating unlimited replacement of suppressor parts. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.
- B. Type L2 Unit - Non Critical Load Applications
1. Voltage Rating: 120/208V, 3-phase, 4-wire
 2. Application: Distribution panel, power, receptacle or lighting panel on system with 120/208V service voltage.
 3. Minimum Modes of Protection: Common or Normal: L-N, L-G, N-G
 4. Maximum acceptable let-through voltage UL 1449 L-N Mode: 700 volts.
 5. Pulse Life Category C3 (<10% drift): 5000 pulses
 6. Minimum acceptable single pulse surge current capacity: 120,000 amps per phase
 7. Short Circuit Current Rating: UL 1449 3rd ED, 100,000 amps minimum
 8. The following models are acceptable:
 - a. Square D Model #TVS2IMA12
 - b. Eaton Model #SPD100208Y2A
 - c. Siemens Energy & Automation Model #TPS3C0110000

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1 and NEC Standards.
- B. Install panelboards plumb. Install recessed panelboards flush with wall finishes. Provide supports in accordance with Section 260529.
- C. Refer to Section 260010 for mounting heights.
- D. Provide breaker closures for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads. See also Paragraph 1.4.C.
- F. Provide engraved plastic nameplates under the provisions of Section 260553.
 1. Indicate the panel designation, voltage, phase, wire and the designation and location of the panel, switchboard or disconnect device which feeds the panelboard.
- G. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Minimum spare conduits: 1 empty 1" per 4 poles of spare breakers and spaces. Identify each as SPARE.
- H. Ground and bond panelboard enclosure in accordance with Section 260526.
- I. Provide a dedicated 3-pole branch circuit breaker to feed TVSS unit (only when required by manufacturer). Circuit breaker size and wire size shall be per manufacturer recommendation. Connect leads to load side of the circuit breaker.

3.2 FIELD QUALITY CONTROL

- A. Perform field inspection and testing.

- B. Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections.
- C. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 10% of each other. Maintain proper phasing for multi-wire branch circuits.
- D. Check tightness of bolted connections, and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.3 PANEL SCHEDULES

- A. As indicated in the Specifications or Drawings.
- B. Schedules show separate wire and conduit sizes for each individual branch circuit. The Contractor may install more than one circuit in a conduit and eliminate unused conduits. The Contractor is responsible for resizing the conduits and providing derated conductors per the requirements of NFPA 70/NEC.

3.4 ADJUSTING

- A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 10% of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION 262416

SECTION 262420

PANELBOARD SCHEDULES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the attached Panelboard Schedule.

1.2 SUBMITTALS FOR REVIEW

- A. Refer to Section 262413 and 262416 for submittals required.

1.3 EXTRA MATERIALS

- A. Refer to Section 262413 and 262416 for extra materials required.

1.4 MAINTENANCE MATERIALS

- A. Refer to Section 262413 and 262416 for maintenance materials required.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 PANELBOARD SCHEDULES

- A. Refer to Panelboard Schedules, attached to the following pages.

3.2 GENERAL NOTES FOR ALL PANEL SCHEDULES

- A. Provide oversize lugs if required by conductors upsized for voltage drop.
- B. Use only owner-assigned room numbers/names in final panel schedules.
- C. Provide ground bus and 100% neutral
- D. Provide "Hinged Trim" panelboard covers for all lighting and power panelboards. The entire trim shall be hinged to swing to one side of the box to access the panel gutter space.
- E. All Panelboards with greater than 42 poles shall have 2 panel backboxes. Single backboxes with more than 42 poles will be unacceptable.

3.3 STANDARD BRANCH CIRCUIT WIRE SIZING TABLE

- A. Sizing Table

PANELBOARD SCHEDULES

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STANDARD BRANCH CIRCUIT WIRE SIZING TABLE			
BREAKER TRIP RATING	1-POLE BREAKER	2-POLE BREAKER	3-POLE BREAKER
15-20A	2#12 + 1#12 GND IN 3/4" CONDUIT	3#12 + 1#12 GND IN 3/4" CONDUIT	4#12 + 1 #12 GND IN 3/4" CONDUIT
25-30A	2#10 + 1#10 GND IN 3/4" CONDUIT	3#10 + 1#10 GND IN 3/4" CONDUIT	4#10 + 1#10 GND IN 3/4" CONDUIT
40-45A	2#8 + 1#10 GND IN 3/4" CONDUIT	3#8 + 1#10 GND IN 3/4" CONDUIT	4#8 + 1#10 GND IN 3/4" CONDUIT
50-55A	2#6 + 1#10 GND IN 3/4" CONDUIT	3#6 + 1#10 GND IN 3/4" CONDUIT	4 #6 + 1#10 GND IN 1" CONDUIT
60-65A	2#4 + 1#8 GND IN 3/4" CONDUIT	3#4 + 1#8 GND IN 3/4" CONDUIT	4#4 + 1#8 GND IN 1-1/4" CONDUIT
70-75A	2#4 + 1#8 GND IN 1" CONDUIT	3#4 + 1#8 GND IN 1" CONDUIT	4#4 + 1#8 GND IN 1-1/4" CONDUIT
80-85A	N/A	3#3 + 1#8 GND IN 1-1/4" CONDUIT	4#3 + 1#8 GND IN 1-1/4" CONDUIT
90-100A	N/A	3#1 + 1#6 GND IN 1-1/2" CONDUIT	4#1 + 1#6 GND IN 1-1/2" CONDUIT

B. Table Notes

1. Unless otherwise indicated, refer to this schedule for wire and conduit size for all circuits with identified breaker trip ratings.
2. Provide neutral conductor for 2 and 3 pole circuits as indicated above if the equipment requires a neutral.

PANEL			Bus:	400A Main Breaker	Additional Panel Notes										
MDP			Volts:	120/208V, 3PH, 4W		100% Neutral with Ground Bus									
			Poles:	42											
			AIC:	42,000											
			Mounting:	Surface											
CKT.	Breaker		Description	Notes	Load						Notes	Description	Breaker		CKT.
	Amp	Pole			A		B		C				Pole	Amp	
1	60	3	TVSS L1	2	0.0	4.7						RTAC-1	3	50	2
3							0.0	4.7							4
5									0.0	4.7					6
7	175	3	Panel LP1	1	9.4	4.7						RTAC-2	3	50	8
9							7.3	4.7							10
11									6.9	4.7					12
13	175	3	Panel LP2	1	18.7	2.9						Air Compressor	2	40	14
15							18.8	2.9							16
17									17.2	2.9		Air Compressor	2	40	18
19	150	3	Panel LP3		11.0	2.9									20
21							11.0	0.6				Vacuum	2	20	22
23									9.0	0.6					24
25	20	2	Spare			0.6						Vacuum	2	20	26
27								0.6							28
29	20	3	Spare									Spare	3	60	60
31															32
33															34
35															36
37															38
39															40
41															42
					54.9		50.6		46.0						
					Phase Totals						Total Connected Load KVA: 151.5 KVA				

PANELBOARD SCHEDULES
262420-3

PANEL			Bus:	225A Main Lugs	Additional Panel Notes										
LP1			Volts:	120/208V, 3PH, 4W	100% Neutral with Ground Bus										
			Poles:	84	Integral TVSS L2										
			AIC:	10,000											
			Mounting:	Surface											
CKT.	Breaker		Description	Notes	Load						Notes	Description	Breaker		CKT.
	Amp	Pole			A		B		C				Pole	Amp	
1	20	1	Lighting		1.4	1.2						Lighting	1	20	2
3	20	1	Lighting				0.9	1.3				Lighting	1	20	4
5	20	1	Receptacles - Rm 101						0.7	0.4		Receptacles - Rm 113	1	20	6
7	20	1	Receptacles - Rm 101,102		0.7	0.4						Receptacles - Rm 113	1	20	8
9	20	1	Receptacles - Rm 104				0.7	0.5				Receptacles - Rm 113	1	20	10
11	20	1	Receptacles - Rm 103						1.1	0.4		Receptacles - Rm 113	1	20	12
13	20	1	Receptacles - Rm 103		1.1	0.4						Receptacles - Rm 113	1	20	14
15	20	1	Water Cooler Receptacle	4			0.2	0.4				Receptacles - Rm 112	1	20	16
17	20	1	Receptacles - Rm 105,106,107						0.7	0.4		Receptacles - Rm 112	1	20	18
19	20	1	Receptacles - Rm 108,125		0.7	0.5						Receptacles - Rm 112	1	20	20
21	20	1	Receptacles - Rm 125				0.2	0.4				Receptacles - Rm 112	1	20	22
23	20	1	Receptacles - Rm 125						1.0	0.4		Receptacles - Rm 112	1	20	24
25	20	1	Receptacles - Rm 125		1.0	0.4						Receptacles - Rm 111	1	20	26
27	20	1	Receptacles - Rm 125				0.4	0.4				Receptacles - Rm 111	1	20	28
29	20	1	Receptacles - Rm 109						0.4	0.5		Receptacles - Rm 111	1	20	30
31	20	1	Receptacles - Rm 109		0.4	0.4						Receptacles - Rm 111	1	20	32
33	20	1	Receptacles - Rm 109				0.5	0.4				Receptacles - Rm 111	1	20	34
35	20	1	Receptacles - Rm 109						0.4	0.4		Receptacles - Rm 114,116	1	20	36
37	20	1	Receptacles - Rm 109		0.4	0.4						Receptacles - Rm 114	1	20	38
39	20	1	Building Lighting				1.0					Spare	1	20	40
41	20	1	Timeclock						0.1			Spare	1	20	42
					9.4		7.3		6.9		Total Connected Load KVA: 43.7 KVA				
					Phase Totals										

PANELBOARD SCHEDULES
262420-4

PANEL			Bus:	225A Main Lugs	Additional Panel Notes										
LP1			Volts:	120/208V, 3PH, 4W	100% Neutral with Ground Bus										
			Poles:	84	Integral TVSS L2										
			AIC:	10,000											
			Mounting:	Surface											
CKT.	Breaker		Description	Notes	Load						Notes	Description	Breaker		CKT.
	Amp	Pole			A		B		C				Pole	Amp	
43	20	1	Receptacles - Rm 121		0.2	0.4						Receptacles - Rm 110	1	20	44
45	20	1	Receptacles - Rm 121				0.4	0.4				Receptacles - Rm 110	1	20	46
47	20	1	Receptacles - Rm 122						0.2	0.5		Receptacles - Rm 110	1	20	48
49	20	1	Receptacles - Rm 122		0.4	0.4						Receptacles - Rm 110	1	20	50
51	20	1	Receptacles - Rm 122				1.0	0.4				Receptacles - Rm 110	1	20	52
53	20	1	Receptacles - Rm 122						0.2	0.5		Receptacles - Rm 124,125	1	20	54
55	20	1	Receptacles - Rm 122		0.7	0.4						Receptacles - Rm 118	1	20	56
57	20	1	Receptacles - Rm 123				1.1	0.4				Receptacles - Rm 118	1	20	58
59	20	1	Receptacles - Rm 123						1.1	0.4		Receptacles - Rm 117	1	20	60
61	20	1	Receptacles - Rm 119		0.4	0.4						Receptacles - Rm 117	1	20	62
63	20	1	Receptacles - Rm 119				0.5	1.0				Receptacles - Rm 117	1	20	64
65	20	1	Receptacles - Rm 120						0.7	1.0		Receptacles - Rm 117	1	20	66
67	20	2	Receptacles - Rm 108		1.0	0.2						Receptacles - Rm 117	1	20	68
69							1.0	0.4				Receptacles - Rm 117	1	20	70
71	20	1	Receptacles - Rm 108							0.4		Receptacles - Rm 117	1	20	72
73	20	1	Spare			1.0						Receptacles - Rm 117	1	20	74
75	20	1	Spare					1.0				Receptacles - Rm 117	1	20	76
77	20	1	Spare							1.0		Spare	1	20	78
79	20	1	Spare									Spare	1	20	80
81	20	1	Spare					1.0				Spare	1	20	82
83	20	1	Spare									Spare	1	20	84
					5.5		8.6		6.0		Total Connected Load KVA: 43.7 KVA				
					Phase Totals										

PANELBOARD SCHEDULES
262420-5

PANEL			Bus:	225A Main Lugs	Additional Panel Notes										
LP2			Volts:	120/208V, 3PH, 4W	100% Neutral with Ground Bus										
			Poles:	42											
			AIC:	10,000											
			Mounting:	Surface											
CKT.	Breaker		Description	Notes	Load						Notes	Description	Breaker		CKT.
	Amp	Pole			A		B		C				Pole	Amp	
1	20	3	V-1		2.0	1.0						V-2, V-3	3	20	2
3							2.0	1.0							4
5									2.0	1.0					6
7	20	3	V-5		1.7	1.3						V-11, V-15	3	20	8
9							1.7	1.3							10
11									1.7	1.3					12
13	20	3	V-7, V-10		1.3	1.3						V-8, V-12	3	20	14
15							1.3	1.3							16
17									1.3	1.3					18
19	20	3	V-13		1.7	1.7						V-9, V-14	3	20	20
21							1.7	1.7							22
23									1.7	1.7					24
25	25	3	ECH-1		1.9	1.9						ECH-1	3	25	26
27							1.9	1.9							28
29									1.9	1.9					30
31	20	2	(2) EWH-1		1.5	1.3						V-4, V-6	3	20	32
33							1.5	1.3							34
35	20	1	EF-1						0.1	1.3					36
37	20	1	EF-2, EF-1		0.1							Spare	3	20	38
39	20	1	Water Heater				0.2								40
41	20	1	Spare												42
					18.7		18.8		17.2						
					Phase Totals						Total Connected Load KVA: 54.7 KVA				

PANELBOARD SCHEDULES
262420-6

PANEL			Bus:	225A Main Lugs	Additional Panel Notes										
LP3			Volts:	120/208V, 3PH, 4W	100% Neutral with Ground Bus										
			Poles:	42	Integral TVSS L2										
			AIC:	10,000											
			Mounting:	Surface											
CKT.	Breaker		Description	Notes	Load						Notes	Description	Breaker		CKT.
	Amp	Pole			A		B		C				Pole	Amp	
1	30	2	Copier Receptacle - Rm 103		0.5	2.5						Washer/Dryer Receptacle - Rm 120	30	2	2
3							0.5	2.5							4
5	20	1	Spare							1.0		Door Hardware Packages	20	1	6
7	20	1	Hand Dryer - Rm 120	4	1.0	0.5						Fire Alarm Panel	20	1	8
9	20	1	Hand Dryer - Rm 105	4			1.0	1.0				Chair Power - Rm 110	20	1	10
11	20	1	Hand Dryer - Rm 106	4						1.0	1.0	Chair Power - Rm 110	20	1	12
13	20	1	Chair Power - Rm 113		1.0	1.0						Utility Center Power - Rm 110	20	1	14
15	20	1	Chair Power - Rm 113				1.0	1.0				Utility Center Power - Rm 110	20	1	16
17	20	1	Utility Center Power - Rm 113						1.0	1.0		Chair Power - Rm 109	20	1	18
19	20	1	Utility Center Power - Rm 113		1.0	1.0						Chair Power - Rm 109	20	1	20
21	20	1	Chair Power - Rm 112				1.0	1.0				Utility Center Power - Rm 109	20	1	22
23	20	1	Chair Power - Rm 112						1.0	1.0		Utility Center Power - Rm 109	20	1	24
25	20	1	Utility Center Power - Rm 112		1.0							Chair Power - Rm 119	20	1	26
27	20	1	Utility Center Power - Rm 112				1.0					Utility Center Power - Rm 119	20	1	28
29	20	1	Chair Power - Rm 111						1.0			Chair Power - Rm 118	20	1	30
31	20	1	Chair Power - Rm 111		1.0							Utility Center Power - Rm 118	20	1	32
33	20	1	Utility Center Power - Rm 111				1.0					Spare	20	2	34
35	20	1	Utility Center Power - Rm 111						1.0						36
37	20	1	Security System Panels		0.5							Spare	30	2	38
39	20	1	Spare												40
41	20	1	Spare									Spare	20	1	42
					11.0		11.0		9.0						
					Phase Totals						Total Connected Load KVA: 31.0 KVA				

PANELBOARD SCHEDULES
262420-7

PANEL NOTES	
1	Refer to Power Riser Diagram for wire and conduit sizes.
2	Provide conductors, overcurrent device and exact placement as recommended by the TVSS manufacturer.
3	Provide groundfault breaker for personal protection.
4	
5	
6	
7	
8	
9	
10	

PANELBOARD SCHEDULES
262420-8

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall switches
- B. Receptacles
- C. Wall Plates
- D. Cord and Plug Sets

1.2 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA WD 1 - General Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
- D. NFPA 70 - National Electrical Code.
- E. UL486A & UL486B
- F. WC-596
- G. WC-896

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate voltage ratings, current rating, color and configuration with specific item and model numbers highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Submit record copy of all testing performed.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

WIRING DEVICES

262726-1

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.
- C. All devices shall meet Federal Spec WC-596 and WC-896.

1.7 COORDINATION

- A. Receptacles for General Contractor or Owner Furnished Equipment: Match plug configurations and ratings.
- B. Cord and Plug Sets: Match equipment requirements.
- C. Coordinate outlet box type and heights with Specification Section 260010.

1.8 EXTRA MATERIALS

- A. Furnish extra materials as described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Wall Plates: 10 of each style, size and finish installed. Furnish at least 2 of each style, size and finish installed.
 - 2. Switches: Furnish 5 of each style, size and finish installed. None required for Indicator Switches and Wall Dimmers.
 - 3. Receptacles: Furnish 10 of each style, size and finish installed. None required for Range and Dryer receptacles.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Single Pole Switch: 120/277V, 20A
 - 1. Hubbell Model CSB120X
 - 2. Leviton Model 1221-2X
 - 3. Pass & Seymour Model CRB20AC1-X
 - 4. Provide 2-pole, 3-way and 4-way switches of the same series as required.
- B. Color: Ivory unless directed otherwise by Architect.

2.2 RECEPTACLES

- A. Duplex Convenience Receptacle: 125V, 20A.
 - 1. Hubbell Model BR20X
 - 2. Leviton Model 5362-X
 - 3. Pass & Seymour Model CRB5362-X
- B. GFCI Receptacle: 125V, 20A.
 - 1. Hubbell Model GF20XLA
 - 2. Leviton Model 8899-X

3. Pass & Seymour Model 2095-X
 4. All GFI Receptacles shall meet the latest Standard 943 for Class A GFI Receptacles/UL 498 for receptacles
- C. GFCI Receptacle: 125V, 20A: Provide for all exterior receptacles.
1. Hubbell Model GFTR20X
 2. Leviton Model W7899-X
 3. Pass & Seymour Model 2095TRWRX
 4. All GFI Receptacles shall meet the latest Standard 943 for Class A GFI Receptacles/UL 498 for receptacles
 5. All GFI Receptacles shall be weather resistant.
- D. Surge Suppressor Receptacle: 125V, 20A
1. Hubbell Model HBL5360XSA
 2. Leviton Model 5380-X
 3. Pass & Seymour Model 5362-XSP
- E. Cord and Plug Sets:
1. Description: Match voltage, current ratings and number of conductors to requirements of equipment being connected.
 - a. Cord: Extra hard usage per NEC.
 - b. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.
- F. Color: Ivory unless directed otherwise by Architect.

2.3 WALL PLATES

- A. Super Stainless Steel Receptacle Cover Plate: Interior Finish Walls - Final finish selection by Architect.
1. Hubbell Model SS8
 2. Leviton Model 84003
 3. Pass & Seymour Model SS8
- B. Super Stainless Steel Switch Cover Plate: Interior Finish Walls - Final finish selection by Architect.
1. Hubbell Model SS1
 2. Leviton Model 84001
 3. Pass & Seymour Model SS1
- C. Metal Receptacle Cover Plate: Electrical Rooms, Mechanical Rooms and Boiler Rooms.
1. Cooper Crouse-Hinds Model TP516
 2. Appleton Model 8365N
 3. Steel City Model RS12
- D. Metal Switch Cover Plate: Electrical Rooms, Mechanical Rooms and Boiler Rooms.
1. Cooper Crouse-Hinds Model TP512
 2. Appleton Model 8361
 3. Steel City Model RS-9
- E. Weatherproof GFI Receptacle Cover Plate: All exterior building mounted receptacles unless otherwise noted.
1. Taymac Model 20310
 2. Hubbell Model WP826MH
 3. Leviton Model 5977-CL
 4. Rating shall be maintained while in use.
 5. Provide horizontal cover if receptacle is mounted horizontally.
- F. Provide all additional combination cover plates of the same series required for the entire project. All devices in the project shall have a cover plate.

- G. Provide all devices, outlet boxes, junction boxes, etc with the appropriate type cover plate.
- H. Provide junior or jumbo size plates as required of the same series and type for all outlets installed in masonry walls.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Coordinate all device rough-in heights and locations with all other trades and finished room schedules as applicable. Report any conflicts to Architect/Engineer before rough-in.
- B. Verify conditions prior to beginning work.
- C. Verify that outlet boxes are installed at proper height.
- D. Verify that wall openings are neatly cut and will be completely covered by wall plates.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation" except for mounting heights. Refer to Section 260010 for mounting heights.
- B. Devices termination may not be used to carry continuity of the branch circuit. All branch circuit wiring must be spliced and tailed out to devices.
- C. Install devices and assemblies plumb and level.
- D. Install switches with OFF position down.
- E. Install ganged wall dimmers as recommended by manufacturer to achieve full rating specified.
- F. Install dedicated neutral conductors on line and load side of dimmers.
- G. Install receptacles with grounding pole on top.
- H. Group adjacent switches or receptacles in single multi-gang wall plates.
- I. Connect wiring device grounding terminal to metallic outlet box with bonding jumper or branch circuit equipment grounding conductor for non-metallic boxes and isolated ground outlets.
- J. Connect wiring devices by wrapping solid conductor around screw terminal. Connect solid and stranded wires by inserting in screw tension pressure plate connectors. Provide solid tails or solderless connectors for stranded conductors where screw tension pressure plates are not available. Use of spring tension back wired terminals is unacceptable.

- K. Coordinate with trade responsible for painting to insure final coat has been applied before installing wall plates.
- L. Provide all devices, outlet boxes, junction boxes, etc. with the appropriate type cover plate.
- M. Use junior or jumbo size plates for all outlets installed in masonry walls.
- N. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on devices installed in surface mounted boxes.

3.4 CONNECTIONS

- A. Ground equipment in accordance with Section 260526.
- B. Wire all devices in accordance with Section 260180.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL-486A and UL-486B.

3.5 FIELD QAUALITY CONTROL

- A. Provide field inspection, testing, adjusting, and balancing.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify that each receptacle device is energized.
- E. Perform the following field tests and inspections:
 - 1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
 - 2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- F. Remove malfunctioning units, replace with new units, and retest as specified above.
- G. Check each TVSS receptacle indicating lights for normal indication.

3.6 ADJUSTING

- A. Adjust installed work as required to meet field conditions.
- B. Adjust devices and wall plates so they are flush and level.

3.7 CLEANING

- A. Clean installed work as required.
- B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 262726

SECTION 262813

FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fuses
- B. Spare Fuse Cabinet

1.2 REFERENCES

- A. NFPA 70 - National Electric Code.
- B. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate electrical characteristics, time curves, fuse coordination on a 11x17" time curve graph paper with specific item or model number highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record actual fuse sizes.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Fuses: Furnish 3 of each size and type installed.

1.8 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cooper Bussman
- B. Littlefuse, Inc.
- C. Ferraz Shawmut

2.2 FUSE REQUIREMENTS

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- C. All fuses in the power distribution system shall be by the same manufacturer.
- D. Main Service Switches Larger than 600 amperes: Current Limiting Class L (time delay).
- E. Motor Load Feeder Switches: Current Limiting Class RK1 (time delay).
- F. Motor Branch Circuits: Class RK5. (time delay).
- G. Parallel service and feeder cables - cable limiters.

2.3 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified.
- B. Doors: Hinged, with hasp for Owner's padlock.
- C. Finish: Primed and painted medium gray.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses in accordance with manufacturer's instructions.
- B. Install fuse with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet where directed by Owner.
- D. Provide an adhesive label inside each enclosure or compartment indicating the size and type of replacement fuse to be installed. Where multiple sizes or types of fuses are installed in a single enclosure placement or coding of labels shall clearly indicate the fuses to which the labels refer.

- E. Install cable limiters on both ends of each parallel cable in the designated set.

END OF SECTION 262813

FUSES
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SECTION 262816

ENCLOSED SWITCHES & CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fusible switches
- B. Nonfusible switches
- C. Enclosed Circuit Breakers

1.2 REFERENCES

- A. NECA - Standard of Installation (Published by the National Electrical Contractors Association).
- B. NEMA FU1 - Low Voltage Cartridge Fuses.
- C. NEMA KS 1 - Enclosed Switches.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (published by the International Electrical Testing Association).
- E. NEMA AB 1 Molded Case Circuit Breakers
- F. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate type, switch ratings, dimensions and enclosure with the specific items or model numbers highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Maintenance Data: Include spare parts data, recommended maintenance procedures and intervals.
- C. Submit record copy of all testing performed.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Installation Instructions: Install in accordance with application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Store, handle, protect,

ENCLOSED SWITCHES & CIRCUIT BREAKERS

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examine, prepare, install, and start the product in accordance with the manufacturer's instructions.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage and are identified with labels describing contents.
 - 1. Fuses: Provide 3 of each size and type of fuse installed.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D Company
- B. Eaton (Cutler Hammer / Westinghouse)
- C. Siemens Energy and Automation
- D. General Electric

2.2 ENCLOSED SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate specified fuses.
- B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. Circuit Breaker: NEMA AB 1.
- B. Service Conditions:
 - 1. Temperature: 104°F
 - 2. Altitude: 6000'

C. Interrupting Rating: As indicated on the drawings.

2.4 MOLDED CASE CIRCUIT BREAKERS - TRIP UNITS

- A. Permanent (fixed) Trip Circuit Breaker: Provide circuit breakers with frame sizes 100 Amps and larger with permanent thermal and magnetic trip units in each pole.
- B. Provide type HCAR circuit breakers for air conditioning and refrigeration branch circuits.

2.5 MOLDED CASE CIRCUIT BREAKERS - OPTIONS AND FEATURES

- A. Provide accessories as scheduled, to NEMA AB 1.
- B. Handle Lock: Include provisions for padlocking.
- C. Load Side Terminations: Provide lugs on circuit breakers of sufficient size to terminate conductors scheduled or indicated on plans.
- D. Provide grounding lug in each enclosure.
- E. Provide Products suitable for use as service entrance equipment where so applied.
- F. Minimum Integrated Short Circuit Rating: Adjusted per Fault-Current Study:
 - 1. Amperes Interrupting Current (AIC) Ratings: 120V, 208V, and 240V breaker - minimum AIC 10,000 amps unless otherwise noted on the Drawings or Specifications.
 - 2. Amperes Interrupting Current (AIC) Ratings: 277V and 480V breaker - minimum AIC 18,000 amps unless otherwise noted on the Drawings or Specifications.
 - 3. The Contractor shall verify the AIC of panelboards with the fault current study and adjust as required to comply with the study.

2.6 ENCLOSURE

- A. Enclosures: NEMA KS 1.
 - 1. Interior Dry Locations: Type 1.
 - 2. Interior Wet Locations: Type 4
 - 3. Exterior Locations: Type 3R.
 - 4. Kitchen: Stainless Steel
 - 5. Dishwashing Rooms/Areas: Stainless Steel

2.7 FUSES

- A. Refer to Section 262813.

2.8 LOAD SIDE TERMINATIONS

- A. Provide lugs on switches of sufficient size to terminate conductors scheduled or indicated on plans.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated and in accordance with NECA "Standard of Installation".
- B. Install fuses in fusible disconnect switches.
- C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.
- D. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions.
- E. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 260529.
- F. Refer to Section 260010 for mounting heights.
- G. Provide engraved plastic nameplates under the provisions of Section 260553.

3.2 FIELD QUALITY CONTROL

- A. Field inspection, testing, adjusting as required.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.
- D. Test and inspect each circuit breaker.
- E. Inspect and test each circuit breaker to NEMA AB 1.
- F. Inspect each circuit breaker visually.
- G. Perform several mechanical ON OFF operations on each circuit breaker.
- H. For record - verify circuit continuity on each pole in closed position.

3.3 ADJUSTING

- A. Adjust work as required.

END OF SECTION 262816

SECTION 264313

DISTRIBUTION SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SCOPE

- A. Work under this section consists of furnishing all materials necessary for the execution and complete installation of surge protective devices.

1.2 REFERENCE STANDARDS

- A. Underwriters Laboratories, Inc. Standard No. 1449 (latest edition).
- B. IEEE Standard C62.45, C62.41 (latest edition)
- C. National Electrical Code Article 240-21 (Equipment complying with tap conductor rules) and Article 110-9 (Interrupting Capacity)
- D. Manufacturer shall be ISO 9001 Certified

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submit booklet to include the following:
 - a. Reference to specification section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate rating, dimensions and finishes with the specific item or model number highlighted.
 - d. Data sheet shall also include type of unit and the protected panels name or reference number(I.E. Type H2 - Panels CP1, CP2 & CP3)
- C. Design Test Documentation (Submit or have on file at the Engineer's office):
 - 1. UL-1449, Third Edition documentation showing Voltage Protection Ratings (VPR) and "Engineering Considerations".
 - 2. Provide test documentation demonstrating that the device has survived the specified VPR rating. Reports will clearly show that tests were performed on a COMPLETE device including all necessary fusing, disconnects and monitoring systems.
 - 3. Provide data confirming that the device is capable of surviving the specified number of repetitive ANSI/IEEE Category C3 (10kA) impulses without failure or performance degradation of more than 10%.
 - 4. Provide test documentation demonstrating that the device is capable of surviving the specified short circuit current rating.

- D. Verification of minimum 10 year warranty.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record actual locations of equipment.
- C. Maintenance Data:

DISTRIBUTION SURGE PROTECTIVE DEVICES

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1. Routing preventive maintenance schedule.
2. Lists of special tools, maintenance materials, and replacement parts.
3. Repair instructions for procedures to check, repair, and test equipment during typical malfunctions.
4. Recommended cleaning methods, frequency, and materials.

1.5 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Units shall consist of parallel connections only. Series components are optional. All MOV's shall be individually fused to provide system redundancy.
- B. The surge protective device must be UL listed under the (UL 1449, Most Recent Edition), UL 1449, Third Edition Voltage protection rating and short circuit current rating must be clearly stated.
- C. Metal Oxide Varistors (MOVs) are to be utilized as the primary suppression components.
 1. Suppression systems shall not employ any other technologies such as gas tubes, spark gap devices, selenium devices or filters.
- D. Enclosures:
 1. Units located in indoor environments shall be provided in heavy duty NEMA 1, or better rated enclosure.
 2. Units located in outdoor environments shall be provided in heavy duty NEMA 3R or better rated enclosure.
 3. Refer to the drawings to determine whether units are for indoor or outdoor applications.
 4. Refer to the drawings to determine whether units are for flush mount or surface mount installations.
 5. SDP units may be installed internal/integral to the gear.
- E. All units shall have active indicator lights, which shall extinguish when protection has failed.
- F. Units must be supplied as part of distribution equipment where UL listed as a complete assembly.
- G. Disconnect switch/overcurrent protection:
 1. See Part 3.1 for more information regarding this feature.
- H. 10 year unconditional warranty.

2.2 TYPE L1 UNIT - NON CRITICAL SERVICE ENTRANCE APPLICATIONS (Type 1 or 2 SPD).

- A. Voltage Rating: 120/208V, 3-phase, 4-wire.
- B. Application: Service entrance panels only.
- C. Minimum modes of protection: Common or Normal: L-N, L-G & N-G.
- D. Maximum acceptable voltage protection rating UL-1449 third edition L-N Mode: 700 volts.

- E. Pulse Life Category C3 (<10% drift): 5,000 pulses
- F. Minimum acceptable single pulse surge current capacity: 120,000 amps per mode (equivalent to 240 kA per phase)
- G. Short Circuit Current Rating: 200,000 amps minimum
- H. The following models are acceptable:
 - 1. Square D Model #TVS2EMA24A
 - 2. Eaton Model #SPD200208Y2K
 - 3. Siemens Energy & Automation Model #TPS3C1230000
 - 4. GE Energy Model #THE120Y125WMN1
 - 5. Advanced Protection Technologies (APT) Model #TE/2XT/240
 - 6. Transtector Systems, Inc. Model #DP300
 - 7. Liebert Corporation Model #LM125120YFNSE

2.3 TYPE L2 UNIT - NON CRITICAL LOAD APPLICATIONS (Type 2 SPD)

- A. Voltage Rating: 120/208V, 3-phase, 4-wire.
- B. Application: Distribution panel, power, receptacle or lighting panel on system with 120/208V service voltage.
- C. Minimum modes of protection: Common or Normal: L-N, L-G & N-G.
- D. Maximum acceptable voltage protection rating UL-1449 third edition L-N Mode: 700 volts.
- E. Pulse Life Category C3 (<10% drift): 5,000 pulses
- F. Minimum acceptable single pulse surge current capacity: 80,000 amps per mode (equivalent to 160 kA per phase)
- G. Short Circuit Current Rating: 200,000 amps minimum
- H. The following models are acceptable:
 - 1. Square D Model #TVS2EMA16A
 - 2. Eaton Model #SPD100208Y2K
 - 3. Siemens Energy & Automation Model #TPS3C0910000
 - 4. GE Energy Model #TME120Y080WMN1
 - 5. Advanced Protection Technologies (APT) Model #TE/2XF
 - 6. Transtector Systems, Inc. Model #SPD120
 - 7. Liebert Corporation Model #ACTII120Y100RKE

2.4 TYPE L3 UNIT - CRITICAL LOAD APPLICATIONS

- A. Voltage Rating: 120/208V, 3-phase, 4-wire.
- B. Application: Distribution panel, power, receptacle or lighting panel on 120/208V system. Supplying power to sensitive digital equipment.
- C. Minimum modes of protection: Common or Normal: L-N, L-G & N-G.
- D. Minimum acceptable single pulse surge current capacity. 60,000 amps per mode (equivalent to 120 kA per phase).
- E. Maximum acceptable voltage protection rating UL-1449 third edition L-N Mode: 700 volts.
- F. The following models are acceptable:

1. Square D Model #TVS2EMA12A
2. Eaton Model #SPD120208Y2K
3. Siemens Energy & Automation Model #TPS3C1220000
4. GE Energy Model #TME120Y065WMN1
5. Transtector Systems, Inc. Model #APEX Series
6. Northern Technology Model #DMK-C Series
7. Liebert Corporation Model #H2120Y100R-01

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The unit shall be installed in accordance with the manufacturer's printed instruction. All local and national codes and regulations must be observed.
- B. Units shall be installed of the same voltage rating as the intended protected equipment.
- C. Units shall be internally/integrally, surface or flush mount to match the intended protected equipment.
- D. Installation of Units:
 1. Install separately enclosed units immediately adjacent to or within the protected panel with the shortest possible lead length without any unnecessary elbows, bends or turns. Where conduit is necessary to install lead connection conductors, leads shall be installed in conduit as required.
 2. Provide a dedicated 3-pole branch circuit breaker in all protected panels for connection. Circuit breaker size and wire size shall be per manufacturer recommendation. Connect leads to the load side of the circuit breaker.
 3. If space is not available in protected panel, provide a 3-pole disconnect switch between the protected panel and the SPD for connection. Fuse and wire size shall be per manufacturer recommendation. Connect leads from the disconnect switch to the main bus (or distribution bus), whichever allows for the shortest total lead length) of the protected panel.

3.2 LOCATIONS

- A. See the power riser drawings for all SPD unit locations and types.

END OF SECTION 264313

SECTION 265100

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior Luminaires and Accessories
- B. Ballasts
- C. Lamps
- D. Exit Signs
- E. Fixture Support Components

1.2 REFERENCES

- A. ANSI C78.379 - Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
- B. ANSI C82.1 - Ballasts for Fluorescent Lamps - Specifications.
- C. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).
- D. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- E. NFPA 70 - National Electrical Code.
- F. NFPA 101 - Life Safety Code.
- G. ANSI/IESNA 500 - 1998 - Recommended Practice for Installing Interior Lighting Systems

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Substitutions: Substitutions will be considered only if submitted no later than 10 days prior to bid.
- C. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section
 - b. A list of all fixtures arranged in order of fixture designation.
 - c. Factory-issued fixture data sheets to indicate features, finishes and dimensions with the specific items or model number highlighted. Photocopies with handwriting are not acceptable.
 - d. Factory-issued accessory sheets to indicate optional items added to the fixtures with the specific item or model number highlighted. Photocopies with handwriting are not acceptable.
 - e. Color samples for luminaires that require color selection.
 - f. Ballast data sheets with the specific item or model number highlighted.

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- g. Lamp data sheets with the specific item or model number highlighted.
 - h. Wiring diagrams for power, signals and control wiring.
 - i. Product certificates for each type of ballast for dimmer-controlled fixtures, signed by the product manufacturer.
 - j. Samples
 - k. Footcandle Layouts
 - l. Fixture Mock-up proposed layout
 - m. All warranties for fixtures, ballasts and lamps.
2. If specification submittal does not list options or data as required, but is indicated as "Write-In" options, a sample of luminaire must accompany the submittal.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Submit a list of all fixtures installed in the system.
- C. Submit data sheets for all fixtures installed with manufacturers operation and maintenance instruction for each type.
- D. Submit replacement parts identification lists and tools required for all fixture types.
- E. Submit a list of types of cleaners to be used on all fixture types.
- F. Submit final As-Built shop drawings.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Conform to requirements of NFPA 101.

1.7 WORK INCLUDED

- A. Conformance: Fixtures shall be manufactured in strict accordance with the Contract Drawings and Specifications.
- B. Specifications and scale drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.
- C. Minor details, not usually indicated on the drawings nor specified, but that are necessary for the proper execution and completion of the fixtures, shall be included, the same as if they were herein specified or indicated on the drawings.

1.8 COORDINATION

- A. Coordinate luminaires with the Room Finish Schedules for type of ceiling construction. The Electrical Contractor shall be responsible for ordering the

proper fixtures and hardware required for installation in or on a specific ceiling.

- B. Coordinate luminaires with Mechanical and Plumbing Contractors and their respective equipment. Conflicts shall be brought to the attention of the Architect prior to installation of luminaires and ceilings. Conflicts not brought to the Architect prior to installation of luminaires and ceilings shall be the Electrical Contractors responsibility for all costs associated with rework of luminaires, piping, ductwork and ceiling grid.

1.9 QUALITY ASSURANCE

- A. Materials, equipment appurtenances as well as workmanship provided under this Section shall conform to the highest commercial standard as specified and as indicated on drawings.

1.10 CEILING TILE REMOVAL

- A. The Contractor shall remove and replace ceiling tile and grid work as required for the installation of electrical work. Damaged tile and grid shall be replaced by the Contractor and shall match the existing ceiling system.

1.11 MAINTENANCE MATERIALS

- A. Provide 2 of each special tool required for maintenance.

1.12 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Lamps: Furnish 1 lamp for every 20 of each type and rating installed. Furnish at least one of each type.
 - 2. Ballasts: Furnish 1 for every 10 of each type and rating installed. Furnish at least one of each type.
 - 3. Batteries: Furnish 1 of each type and rating installed.
 - 4. Glass and Plastic Lenses, Covers and Other Optical Parts: Furnish 2 of each type and rating installed.
 - 5. Globes and Guards: Furnish 2 of each type and rating installed.

1.13 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Luminaires:
 - 1. Refer to the Luminaire Schedule.
- B. Lamps:
 - 1. General Electric
 - 2. Philips
 - 3. Osram/Sylvania
- C. Ballasts:

1. Osram/Sylvania
2. Advance
3. Universal

- D. Dimming Ballasts:
1. Lutron
 2. Osram/Sylvania
 3. Advance
 4. Universal

2.2 LUMINAIRES AND COMPONENTS (GENERAL)

- A. Metal Parts: Free of burrs, sharp corners and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting surfaces shall be minimum reflectance as follows:
1. White - 85%
 2. Specular - 83%
 3. Diffusing Specular - 75%
 4. Laminated Silver Metalized Film - 90%
- E. Lenses, Diffusers, Covers and Globes:
1. 100% virgin acrylic plastic, high resistance to yellowing and other changes due to aging, heat and UV radiation.
 - a. Lens Thickness: At least 0.125 in minimum
 - b. UV Stabilized
 2. Glass: Annealed crystal glass unless otherwise indicated.
- F. Luminaires subject to damage shall be equipped with approved heavy duty metal guards.
- G. Luminaires exposed to weather shall be weatherproof, gasketed provided with aluminum boxes and trim of stainless steel, cast aluminum or other non-ferrous material.
- H. Furnish all necessary materials, accessories and any other equipment required for the complete and proper installation and operation of all lighting fixtures included in this contract.
- I. All lighting fixtures to be listed and labeled by UL or other testing agency acceptable to local code and authorities for installation in fireproof or non-fireproof construction, damp or wet locations as required.
- J. Provide luminaires with all associated appurtenances including, but not necessarily limited to, lamps, ballasts, reflectors, lenses and/or louvers, sockets, holders, suspension accessories, pendants, canopies, recessing boxes, plaster frames and similar items completely wired, assembled, installed and tested as specified and in the manner indicated.
- K. All fluorescent troffer-type lighting fixtures shall be designed to completely eliminate light leakage between the fixture body and doorframe and shall be provided with positive acting, hinge and latch flush doorframes.

- L. All recessed fluorescent, incandescent, and high intensity discharge lighting fixtures shall be provided with an integral, automatic resetting, thermal cutout.
- M. All Alzak-type of reflector cones and louvers used with any tri-phosphor type of fluorescent lamp shall be specially anodized in order to eliminate iridescence.
- N. Every luminaire symbol shall have a luminaire number unless otherwise directed. In instances where a specific luminaire symbol has not been assigned a luminaire number, provide a complete luminaire of the type and wattage designated for luminaire symbols of similar function and/or as directed by the Architect.
- O. All luminaires shall be UL listed or assembled from UL components.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. General Requirements for Electronic Ballasts:
 - 1. Comply with UL 935 and ANSI C82.11
 - 2. Designed for type and quantity of lamps served.
 - 3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
 - 4. Sound Rating: Class A
 - 5. Total Harmonic Distortion Rating: Less than 10%
 - 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 - 7. Operating Frequency: 42 kHz or higher.
 - 8. Lamp Current Crest Factor: 1.7 or less.
 - 9. BF: 0.85 or higher.
 - 10. Power Factor: 0.95 or higher.
 - 11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
- B. Electronic Programmed-Start Ballasts for T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:
 - 1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
 - 2. Automatic lamp starting after lamp replacement.
 - 3. Sound Rating: Class A
 - 4. Total Harmonic Distortion Rating: Less than 20%
 - 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 - 6. Operating Frequency: 20 KHz or higher.
 - 7. Lamp Current Crest Factor: 1.7 or less.
 - 8. BF: 0.95 or higher, unless otherwise indicated.
 - 9. Power Factor: 0.95 or higher.
- C. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.
- D. Ballasts for Low-Temperature Environments:
 - 1. Temperatures 0°F and Higher: Electronic type rated for 0°F starting and operating temperature with indicated lamp types.
 - 2. Temperatures -20°F and Higher: Electromagnetic type designed for use with indicated lamp types.
- E. Ballasts for Dimmer Controlled Lighting Fixtures: Electronic type.
 - 1. Dimming Range: 100 to 5% of rated lamp lumens.
 - 2. Ballast Input Watts: Can be reduced to 20% or normal.
 - 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

- F. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type:
 - 1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
 - a. High-Level Operation: 100% of rated lamp lumens
 - b. Low-Level Operation: 30% of rated lamp lumens.
 - 2. Ballast shall provide equal current to each lamp in each operating mode.
 - 3. Capability: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.
- G. Ballasts for Tri-Level Controlled Lighting Fixtures: Electronic type:
 - 1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high-and low-level and off.
 - a. High-Level Operation: 100% of rated lamp lumens.
 - b. Low-Level Operation: 30% and 50% of rated lamp lumens.
 - 2. Ballast shall provide equal current to each lamp in each operating mode.
 - 3. Compatibility: Certified by manufacturer for use with specific tri-level control system and lamp type indicated.
- H. Provide lamps for all lighting fixtures furnished in the project. Contractor to verify that lamps installed in fixtures are of the type recommended by the manufacturer.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic-programmed rapid-start type, complying with UL 935 and ANSI C82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated.
 - 1. Lamp end-of-life detection and shutdown circuit.
 - 2. Automatic lamp starting after lamp replacement.
 - 3. Sound Rating: Class A
 - 4. Total Harmonic Distortion Rating: Less than 20%.
 - 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 - 6. Operating Frequency: 20 KHz or higher.
 - 7. Lamp Current Crest Factor: 1.7 or less.
 - 8. BF: 0.95 or higher unless otherwise indicated.
 - 9. Power Factor: 0.95 or higher.
 - 10. Interface: Comply with 47CFR18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
 - 11. Ballast Case Temperature: 75°C maximum.

2.5 BALLASTS FOR HID LAMPS

- A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:
 - 1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power factor type.
 - 2. Minimum Starting Temperature Minus 22°F for single-lamp ballasts.
 - 3. Rated Ambient Operating Temperature: 104°F
 - 4. Open-circuit operation that will not reduce average life.
 - 5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
- B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
 - 1. Minimum Starting Temperature: Minus 20°F for single-lamp ballasts.
 - 2. Rated Ambient Operating Temperature: 130°F
 - 3. Lamp end-of-life detection and shutdown circuit.

4. Sound Rating: Class A
 5. Total Harmonic Distortion Rating: Less than 20%
 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 7. Lamp Current Crest Factor: 1.5 or less
 8. Power Factor: 0.90 or higher
 9. Interference: Comply with 47 CFR 18. Ch 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
 10. Protection: Class P thermal cutout.
 11. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.
 - a. High-Level Operation: 100% of rated lamp lumens.
 - b. Low-Level Operation: 50% of rated lamp lumens.
 - c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
 12. Continuous Dimming Ballast: Dimming range shall be from 100 to 35% of rated lamp lumens without flicker.
 - a. Ballast Input Watts: Reduced to a maximum of 50% of normal at lowest dimming setting.
- C. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 90°C.
1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150W.
 2. Minimum Starting Temperature: Minus 40°F.

2.6 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80% of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

- C. Wireguards: Provide wireguards for all exit signs located in the Gymnasiums, Locker Rooms, Multi-Purpose Rooms, Electrical Rooms, Mechanical Rooms, Boiler Rooms and all other areas indicated on the drawings.

2.7 FLUORESCENT LAMPS

- A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48", 3100 initial lumens (minimum), CRI 85 (minimum), color temperature 3500K and average rated life 30,000 hours, unless otherwise indicated.
- C. T8 rapid-start low-mercury lamps, rated 25W maximum, nominal length of 36", 2200 initial lumens (minimum), CRI 85 (minimum), color temperature 3500K, and average rated life of 30,000 hours, unless otherwise indicated.
- D. T8 rapid-start low-mercury lamps, rated 17W maximum, nominal length of 24", 1400 initial lumens (minimum), CRI 85 (minimum), color temperature 3500K, and average rated life of 30,000 hours, unless otherwise indicated.
- E. T5 rapid-start low-mercury lamps rated 28W maximum, nominal length of 45.2", 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3500K, and average rated life of 30,000 hours, unless otherwise indicated.
- F. T5 rapid-start low-mercury lamps rated 14W maximum, nominal length of 45.2", 1400 initial lumens (minimum), CRI 85 (minimum), color temperature 3500K, and average rated life of 30,000 hours, unless otherwise indicated.
- G. T5HO rapid-start, high-output low-mercury lamps, rated 54W maximum, nominal length of 45.2", 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 30,000 hours, unless otherwise indicated.
- H. Compact Fluorescent Lamps: 4-pin, low mercury, CRI 80 (minimum), color temperature 3500K, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.
 - 1. 13W: T4, double or triple tube, rated 900 initial lumens (minimum).
 - 2. 18W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 - 3. 26W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 - 4. 32W: T4, triple tube, rated 2400 initial lumens (minimum).
 - 5. 42W: T4, triple tube, rated 3200 initial lumens (minimum).
 - 6. 57W: T4, triple tube, rated 4300 initial lumens (minimum).
 - 7. 70W: T4, triple tube, rated 5200 initial lumens (minimum).
- I. Provide lamps for all luminaires furnished in the project. Contractor to verify that lamps installed in luminaires are of the type recommended by the manufacturer.

2.8 HID LAMPS

- A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900K, and average rated life of 24,000 hours, minimum.
 - 1. Dual-Arc Tube Lamps: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15% of normal light output.
- B. Pulse Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000K.

- C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80 and color temperature 4000K.
- D. Provide lamps for all luminaires furnished in the project. Contractor to verify that lamps installed in luminaires are of the type recommended by the manufacturer.

2.9 FINISHES

- A. Manufacturer's standard color, unless otherwise indicated in Luminaire Schedule to be "custom color".

2.10 FIXTURE SUPPORT COMPONENTS

- A. Single-Stem Hangers: ½" steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- B. Twin-Stem Hangers: Two, ½" steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated, 12 gauge.
- D. Rod Hangers: 3/16" minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.
- G. Safety Cables: Install manufacturer's standard safety cable on all fixtures in the Gymnasium.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set all luminaires level, secure, plumb and square with ceilings and walls according to manufacturer's written instructions or approved shop drawing.
- B. Install lamps in all fixtures. Contractor to verify that lamps installed in fixtures are of the type recommended by the manufacturer.
- C. Support for Fixtures in or on Grid-Type Suspended Ceilings:
 - 1. Provide a minimum of 4 ceiling independently supported rods or wires for each fixture. Locate at the fixture corners.
 - 2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and provide support of fixtures independently with at least two ¾" metal channels spanning and secured to ceiling tees.
 - 4. Provide at least 1 independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- D. Suspended Fixture Support: As follows:
 - 1. Pendants and Rods: Where longer than 48", brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- E. Support luminaires according to manufacturer's requirements.
 - F. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
 - G. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
 - H. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.
 - I. Install recessed luminaires to permit removal from below.
 - J. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
 - K. Install clips to secure recessed grid-supported luminaires in place.
 - L. Install wall mounted luminaires, emergency lighting units and exit signs at height as indicated on Drawings or as directed by Architect.
 - M. Install accessories furnished with each luminaire.
 - N. Adjust aimable fixtures to provide required light intensities.
 - O. Provide wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
 - P. Bond products and metal accessories to branch circuit equipment grounding conductor.
 - Q. Fixture Locations: Do not scale electrical drawings for exact location of the lighting fixtures. In general, the architectural reflected ceiling plans indicate the proper locations of lighting fixtures.
 - R. Appurtenances: Install each fixture properly and safely. Furnish and erect hangers, rods, mounting brackets, supports, frames, and other equipment required.
 - S. Coordination: Furnish lighting fixtures complete with appurtenances required for the proper, safe and distortion-free installation in the various surfaces in which they appear. Determine surface types from the Architectural drawings.
 - T. Install lighting fixtures in strict conformance with manufacturer's recommendations and instructions.
 - U. Rigidly align continuous rows of lighting fixtures for true in-line appearance.
 - V. Do not install fixtures and/or parts such as finishing plates, lenses and trims for recessed fixtures until all plastering and painting that may mar fixtures finish has been completed.
 - W. Mechanical Rooms: Lighting fixture locations in mechanical and electrical equipment rooms are approximate. Coordinate mounting height and location of lighting fixtures to clear mechanical, electrical and plumbing equipment and to illuminate adequately meters, gauges, and equipment.

- X. Concealment: Whenever a fixture or its hanger canopy is applied to a surface mounted outlet box. Provide a finishing ring to conceal the outlet box.
- Y. Replace blemished, damaged or unsatisfactory fixtures as directed.

3.2 CONNECTIONS

- A. Ground Lighting Units: Tighten electrical connectors and terminals, including grounding connections, according to manufacturers published torque-tightening values. Where manufacturers torque values are not indicated, use those specified in L 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Tests: Verify normal operation of each luminaire after luminaires have been installed and circuits have been energized with normal power source. Interrupt electrical energy to demonstrate proper operation of emergency lighting system.
- C. Replace or repair malfunctioning luminaires and components, then retest. Repeat procedure until all units operate properly.
- D. Report results of tests.
- E. Replace luminaires that show evidence of corrosion during project warranty period.

3.4 ADJUSTING AND CLEANING

- A. Clean luminaires after installation. Use methods and materials recommended by manufacturer.
- B. Adjust luminaires to provide required light intensities

3.5 START-UP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage or as recommended by manufacturer.

END OF SECTION 265100

SECTION 265200

LUMINAIRE SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the attached Luminaire Schedule.
- B. The fixture manufacturers' catalog numbers scheduled hereinafter in the Luminaire Schedule may not include all the required accessories or hardware that is necessary for a complete installation. Provide all the required accessories or hardware that is necessary for a complete installation.
- C. Furnish luminaries with all associated appurtenances including, but not necessarily limited to, lamps, ballasts, reflectors, lenses and/or louvers, sockets, holders, suspension accessories, pendants, canopies, recessing boxes, plaster frames, and similar items completely wired, assembled, installed and tested as specified and in the manner indicated.
- D. Every luminaire symbol shall have a luminaire number unless otherwise directed. In instances where a specific luminaire symbol has not been assigned a luminaire number, provide a complete luminaire of the type and wattage designated for a luminaire symbol of similar function and/or as directed by the Architect.

1.2 LUMINAIRE SCHEDULE INTERPRETATION

- A. The first name luminaire manufacturer and catalog number is the Basis of Design for the intended usage. Additional luminaire manufacturers and catalog series of luminaries listed in the Luminaire Scheduled or added thru addenda are approved equals and may be subject to sample review, footcandle layout for rooms utilizing luminaire and/or a mock-up for Engineer review before final approval will be given.

1.3 MAINTENANCE MATERIALS

- A. Provide 2 of each special tool required for maintenance.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 LUMINAIRE SCHEDULE

- A. Refer to Luminaire Schedule attached to the following pages.

LUMINAIRE SCHEDULE

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SECTION 265200

LUMINAIRE SCHEDULE

Mark	Manufacturer	Catalog Number	Description	Volts	Lamps			Ballasts		Mtg.	Mtg. Height	Notes
					No.	Watts	Type	No.	Type			
F1	Daybrite HE Williams Lithonia Coronet	2AVE228-PMW-UNV-EB10I DI series 2AV series TSSW series	2'x4' fluorescent recessed direct/indirect troffer	UNV	2	28	F28WT5/835	1	2LE	RC		
F2	Daybrite HE Williams Lithonia Coronet	2AVE214-PMW-UNV-EB10I DI series 2AV series TSSW series	2'x2' fluorescent recessed direct/indirect troffer	UNV	2	14	F14WT5/835	1	2LE	RC		
F3	Daybrite HE Williams Lithonia Coronet	2AVE214-PMW-UNV-EB10I-E5 DI series 2AV series TSSW series	2'x2' fluorescent recessed direct/indirect troffer with emergency ballast	UNV	2	14	F14WT5/835	1	2LE	RC		4
F4	Day-Brite Columbia Lithonia Metalux	2SPG228R-FS12-UNV-1/2-EB 2ST8 series 2SP5 series 2GC series	2'x4' fluorescent lensed troffer	UNV	2	28	F28WT5/835	1	2LE	RC		
F5	Alco Kenall Lumentask Tech Lighting	ARIS-21-301-120-PRL-HWC-AMB21 AUCLED series LUC series 700UCF series	21" undercabinet	UNV	-	-	LED	1	LED	UC		1,2
F6	Alco Kenall Lumentask Tech Lighting	ARIS-41-301-120-PRL-HWC-AMB41 AUCLED series LUC series 700UCF series	41" undercabinet	UNV	-	-	LED	1	LED	UC		1,2
F7	Daybrite Columbia Lithonia Metalux	SWN228-UNV-1/2-EB AW series LB series WS series	1'x4' fluorescent surface wraparound	UNV	2	28	F28WT5/835	1	2LE	RC		
F8	Chloride Emergi-Lite Lithonia Sure-Lites	CXXL3RW WPREMDN series LQM series LPX series	LED exit sign with battery pack	UNV	-	-	LED	-	-	SW/SC		3
F9	Chloride Emergi-Lite Lithonia Sure-Lites	PLACEMW LUX series AFN series AEL2 series	Remote Head	UNV	-	-	Xenon	-	-	SW	6" above door	

LUMINAIRE SCHEDULE
265200-2

Mark	Manufacturer	Catalog Number	Description	Volts	Lamps			Ballasts		Mtg.	Mtg. Height	Notes
					No.	Watts	Type	No.	Type			
F10	Omega Prescolite Gotham Portfolio	OM4LED28120-R4LED35KCSS LF4 series EVO series LD4 series	LED downlight	UNV	-	-	LED	1	1LE	RC		
F11	Daybrite Columbia Lithonia Metalux	SWN214-UNV-1/2-EB AW series LB series WS series	1'x2' fluorescent surface wraparound	UNV	2	14	F14WT5/835	1	2LE	RC		
SF1	Gardco Invue Kim Lighting Lithonia	101L-3-35LA-NW-UNIV-BRP ENV series WC series WSQ series	35W LED wall-mounted fixture	UNV	-	-	35W LED	-	-	SW	6" Above Door	5
SF2	Gardco Invue Kim Lighting Lithonia	101L-3-55LA-NW-UNIV-BRP ENV series WC series WSQ series	55W LED wall-mounted fixture	UNV	-	-	55W LED	-	-	SW	12'-0" AFG	5

Ballast Legend	
Symbol	Description
FD	Fluorescent dimming as specified.
1LE	One lamp electronic
2LE	Two lamp electronic
3LE	Three lamp electronic
4LE	Four lamp electronic
HID	Standard high intensity discharge
ER	Electro-regulating HID
PS	Pulse start HID
SD	Step Dimming

Mounting Legend			
Symbol	Description	Symbol	Description
RC	Recessed Ceiling	S	Suspended
RW	Recessed Wall	UC	Under Cabinet
SC	Surface Ceiling	PD	Per Detail on Drawings
SW	Surface Wall	PM	Pole Mounted
CH	Chain Hung	IG	Recessed In-Ground
AH	Aircraft Cable Hung	PT	Pole Top Mounted
P	Pendant	G	Ground Mounted
WB	Wall Bracket	B	Bollard
C	Cove		

General Notes	
G1	Check descriptions against catalog numbers. Report any discrepancies prior to submitting a proposal for this work.
G2	Where the listed manufacturer of acceptacle substitutes makes more than one grade of the fixture, provide the grade of fixture with equal or better construction, materials and performance as determined by the manufacturer.

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G3	All fluorescent lamps shall be ECO/ALTO low mercury type.
G4	Engineer must approve all substitutes prior to bid.
G5	All Recessed 1x4, 2x2 and 2x4 fixtures shall have spring-loaded latches. Cam action (friction) latches are not acceptable.
G6	All ballasts shall be Universal 120-277 voltage.
G7	Refer to Specifications Sections 265100 for additional requirements.

Luminaire Schedule Notes	
1	Coordinate exact locations of fixtures with Architectural elevations and approved shop drawings.
2	Provide connectors, cables and all additional accessories for a complete installation.
3	Provide all additional mounting accessories for each application.
4	Provide bodine emergency ballast for luminaire.
5	Color shall be bronze. Provide samples for Architect to approve.

END OF SECTION

LUMINAIRE SCHEDULE
265200-4

SECTION 266030

ELECTRIC HAND DRYERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electric hand dryers.

1.2 REFERENCES

- A. Underwriter's Laboratory, Inc. (UL).

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Reference to Specification Section.
 - 2. A list of all equipment to be provided and installed.
 - 3. Data sheets to indicate voltage with specific items or model numbers highlighted.
 - 4. Installation methods.
- C. Submittal booklet to include the following:
 - 1. Reference to Specification Section.
 - 2. A list of all equipment to be provided and installed.
 - 3. Data sheets to indicate voltage with specific items or model numbers highlighted.
 - 4. Installation methods.

1.4 QUALITY ASSURANCE

- A. Product Requirements: Hand dryers shall be certified by Underwriters Laboratory (UL), Inc. and shall bear UL labels.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results.

1.7 WARRANTY

- A. Provide the warranty specified in Section 260010.

ELECTRIC HAND DRYERS

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. World Dryer Corp.
 - 1. Phil Butler (708-234-8959) phil.butler@worlddryer.com

2.2 ELECTRIC HAND DRYERS

- A. SMARTdri PLUS Model: K-973P (stainless steel, brushed housing) with KKR-973 recess kit. Provide the quantity shown on the drawings.
- B. Motor: Universal type, through-flow discharge vacuum type with automatic resetting thermostat; 1.07 HP, 23,400 RPM. Air flow rate: 250 mph (22,000 linear feet per minute) at air outlet at 77 cubic feet per minute.
- C. Heater: Nichrome wire element mounted inside plenum housing with dual level safety protection - automatic resetting thermostat to open when air flow is restricted and close when air flow is resumed with back-up one use thermal cutoff.
- D. Dryer Controls: Three (3) position motor control and ON/OFF heater control to customize air performance / dry time, energy efficiency, sound level and user comfort as desired.
- E. Intake air filter to prevent debris from entering sensitive dryer components and improve serviceability and life.
- F. Sound Level at 2 Meters, No Hands: 68 dBA (Motor Setting - Hi); 63 dBA (Motor Setting - MED); 59 dBA (Motor Setting - Low).
- G. Automatic Activation: Active infrared sensor, 30 second vandal shut-off.
- H. Surface Treatment: Steritouch, patented anti-bacterial technology.
- I. Ingress Protection Rating: IP24.
- J. Mounting: Provide surface mounted units.
- K. Mounting: Mount recessed units in compliance with ADA guidelines.
- L. Voltage: 120v with dedicated 15 amp ground fault circuit breaker.
- M. Recess Kit: 16 GA 18-8 type 304 stainless steel recessing kits with brushed finish for SMARTdri electric hand dryer.
- N. Warranty: 5 YR Limited Warranty.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate requirements for blocking to ensure adequate means for support and installation of hand dryers.

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- B. Coordinate requirements for power supply, conduit, disconnect switches, and wiring.
- C. Coordinate dryer installation with application of wall finishes.

3.2 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.3 INSTALLATION

- A. Comply with manufacturer's written installation instructions and approved shop drawings.
- B. Provide a ground fault breaker to feed all hand dryers.
- C. Mount hand dryers at 37" from floor to dryer bottom edge.
- D. Install dryers with recess mounting kits such that maximum projection from wall surface is 4 inches in compliance with ICC/ANSI A117.1.

3.4 CLEANING, TESTING AND DEMONSTRATING

- A. Remove protective wrappings. Clean surfaces with mild soap solution. Do not use abrasives.
- B. Inspect installed dryers to verify mounting is rigid and electrical connections are proper. Test each dryer to verify operation and performance. Correct deficiencies.
- C. Protect dryers from remaining construction activities. Immediately remove and replace dryers that are damaged.
- D. Demonstrate operation and maintenance to Owner's representative.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 266030

SECTION 271400

TELECOMMUNICATIONS CABLING, CONNECTORS & EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. UTP Cables and Equipment
- B. Telephone Cables and Equipment
- C. Modular Jacks and Mounting Hardware
- D. Equipment Racks
- E. Backboards
- F. Wire Management
- G. Lightning Protection
- H. Labeling

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
- C. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard
- D. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling And Components Standard
- E. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard
- F. BISCO - Telecommunications Distribution Methods Manual (Current Edition)
- G. NEMA WD-6: Wiring Devices - Dimensional Requirements
- H. ANSI/TIA/EIA-607 - Grounding and Protection of Telecommunication Cables and Equipment.
- I. EIA 310-D: Cabinets, Racks, Panels and Associated Equipment.
- J. EIA/TIA-604-3: Fiber Optic Connector Interconnectability Standard.
- K. ANSI/ICEA S-80-576: Industry Color codes
- L. UL 910/NFPA 262: Test method for fire and smoke characteristics of electrical and optical-fiber cables used in air handling spaces.
- M. UL 1666: Flame propagation height of electrical and optical-fiber cables installed vertically in shafts.

TELECOMMUNICATIONS CABLING, CONNECTORS & EQUIPMENT

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1.3 SYSTEM REQUIREMENT

- A. All cables Specified are to be supplied in "plenum-rated" versions for this installation.
- B. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum performance.

1.4 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following;
 - a. Reference to Specification Section
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate dimensions, knockout sizes, material, fabrication details, finishes and accessories with specific item or model number highlighted.
 - d. Data sheet to indicate each cable type including number of pairs, punch down block, outlet/connectors with the specific item or model number highlighted.
 - e. Data sheets to indicate supply dimensions, ETL-verified electrical characteristics and parameters, upgrade/expansion data, and mounting methods for all hardware and materials with the specific item or model numbers highlighted.
- C. Submit manufacturer warranty certificate stating length of warranty, other accepted component manufacturers and overall testing/replacement responsibility.
- D. Submit product certificates signed by manufacturers of cables, connectors, and equipment certifying that products furnished comply with requirements and warranty is valid with equipment installed.
- E. Submit evidence that all qualifications have been met.
- F. Submit make/model numbers of testers to be used for all testing of cables.
- G. Labeling Scheme: Submit labeling scheme for cabling, outlets and equipment for approval.
 - 1. Contractor to coordinate with Owner for final room designations utilized in applied labeling scheme. Labeling schemes applied without documented Owner coordination are subject to removal and re-application by Contractor.
 - 2. All labels are to be typed.

1.5 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. As-Built Drawings: Provide a marked-up copy of original plans which reflect any changes or additions not shown on the plan. Identify all cable and jack numbering as identified on site and in System Final Test Report. Indicate routing of all IDF to MDF cabling.
- C. Submit Test Report for each basic link from patch panel to jack/patch panel. Report to include test equipment type and calibration data, date and operator.
- D. Submit electronic copy of final comprehensive schedules for project, in software and format selected by Owner.

- E. Submit manuals indicating enclosures, accessories and spare parts.
- F. Record actual locations of outlets and sizes of pathways.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Supplier: Authorized or Franchised distributor of specified manufacturer with minimum three years documented experience.
- C. Installer: Authorized or franchised installer of specified manufacturers with five years documented experience.
- D. Provide two references of network installation, which exceeded 200 drops and were completed within the last 12 months,
- E. Installer must be able to identify and correct non-compliance in structured cabling systems. Provide the name of a fulltime RCDD employed by the installing company.
- F. Provide satisfactory evidence of a fully equipped service organization, capable of furnishing adequate inspection and service to the system, including standard replacement parts within 50 miles of the project site.
- G. Perform all terminations at device and headend locations using the hereby qualified installation firm.
- H. Supervise and approve all cable pulls in accordance with warranty requirements of the certifying company.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories, Inc. or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 COORDINATION

- A. Coordinate work of this section with telephone switch and telephone instruments provided as part of this project.
 - 1. Adjust arrangements and locations of equipment racks, cabinets, backboards, patch panels, and cross connects in IDF/MDF Rooms and consolidation points to accommodate and optimize arrangement and space requirements. Review revised layouts with Engineer before proceeding with work.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer.
- B. Store products in dry spaces protected from the weather. The storage temperature shall be 68°F to 122°F.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of complete data cabling system for one year from Date of Substantial Completion of project at no additional cost to Owner.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Fiber Optic Patch Cables of sufficient length to replace any similar cable installed in the project: Furnish 2 of each type installed.
 - 2. UTP Patch Cables of sufficient length to replace any similar cable installed in the project: Furnish 10 of each type installed.
 - 3. Connector Modules: Furnish 10 of each type and rating installed.
 - 4. Wall Plates: Furnish 10 of each type and rating installed.

1.12 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 UTP RACK MOUNT PATCH PANELS FOR DATA

- A. Manufacturers:
 - 1. Hubbell Premise Wiring
 - 2. ADC/Krone
 - 3. The Seimon Company
 - 4. Amp, Inc.
- B. Basis Of Design - Hubbell Premise Wiring NEXTSPEED Category 6 Patch Panels
- C. Design Requirements:
 - 1. Category 6 patch panels shall be standard 8-position, RJ-45 style, un-keyed, FCC-compliant receptacle, in 24- and 48-port configurations. 96-Port will not be acceptable.
 - 2. Panel frames shall be black powder coated 14-gage steel with rolled edges top and bottom for proper stiffness.
 - 3. Panel design shall incorporate plastic push-fasteners to permit hands-free positioning onto standard EIA-310-D 19" mounting rails.
 - 4. Panels shall accommodate a minimum of 24 ports for each rack mount unit (1 RMU = 1.75 in.).
 - 5. Panels shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
 - 6. Panels shall terminate 26-22 AWG solid conductors, with maximum insulation diameter of 0.050 in.
 - 7. Panels shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 - 8. Panels shall have individual port identification numbers on the front and rear of the panel.
 - 9. Panels shall utilize 8-port adapter modules, each secured with two screws. Adapter module housings shall be UL 94 V-0 rated thermoplastic.
 - 10. Panel adapter modules shall be 110-style termination with tin lead solder plated IDC contacts.
 - 11. Printed circuit boards shall be fully enclosed front and rear for physical protection.

12. Panel contacts shall withstand a minimum of 2000 mating cycles with an FCC 8-position RJ-45 plug, without degradation of electrical or mechanical performance.
13. Panel contacts shall be constructed of Beryllium copper for maximum spring force and durability.
14. Contact plating shall be a minimum of 50 micro-inches of hard gold in the contact area over 50 micro-inch of nickel.
15. Panel termination method shall follow the industry standard 110 IDC punch-down, using a standard 110 impact termination tool.
16. Panels shall be compatible with a 4-pair multi-punch impact termination tool designed specifically for the purpose. Bending or other damage to the panel using a multi-pair punch tool shall not occur.
17. IDC contacts shall be Phosphor Bronze with 100 micro-inch tin lead 60/40 plating over nickel.
18. P6E series panel adapter ports shall accept optional hinged dust covers.
19. P6E series panel adapter ports shall accept snap-on icons for specific identification.
20. Space above the adapter ports shall be available for additional labeling per ANSI/TIA/EIA-606-A.
21. Category 6 panels shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form, and function.
22. Panels shall accept a clip-on rear cable management support bar to provide cable strain relief.
23. Panels shall include self-adhesive, clear label holders for each row of 24 ports.

D. Performance Requirements:

1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
2. Category 6 panels shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C.2, Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling.
3. The manufacturer shall provide Category 6 component compliance certificates from third party testing organizations upon request.
4. Panels shall be UL LISTED 1863 and CSA certified.
5. Panels shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
6. Panel contacts shall withstand a minimum of 2000 mating cycles with an FCC 8-position RJ-45 plug, without degradation of electrical or mechanical performance.
7. Panels shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.
8. Category 6 panels shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 - 250 MHz when configured in a 4-connector channel.
9. Category 6 panels shall meet or exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-C.2 standard.
10. The 4-connector channel test configuration shall utilize Category 6 patch panels, Category 6 jack, and Category 6 patch cords, from the same manufacturer, with qualified Category 6 cable.
11. The 4-connector channel performance margins in the table below shall be guaranteed. Conditions of requirement No. 10 above apply.
12. Category 6 panels shall meet the current draft 10 Gb/s performance requirements of IEEE 802.3 and TSB-155, for a maximum 55-meter channel length. Conditions of requirement No. 10 above apply.

Electrical Parameter (1 - 250MHz)	Guaranteed Margins to Category 6 / Class E Channel Specifications
Insertion Loss	3 %
NEXT	4 dB
PSNEXT	5 dB

ELFEXT	4 dB
PSELFEXT	5 dB
Return Loss	2 dB

2.2 UTP CABLES FOR DATA

- A. Manufacturers:
1. Hubbell Premise Wiring
 2. Berk-Tek, Inc.
 3. Amp, Inc.
 4. Superior Essex Inc.
 5. Mohawk
 6. General
 7. Hitachi Cable
- B. Basis of Design - Hubbell Premise Wiring NEXTSPEED Category 6 Plenum UTP Cable.
- C. Design Requirements:
1. Cable construction shall be four twisted pairs of 23 AWG insulated solid conductors, with a ripcord, surrounded by a tight outer jacket.
 2. Cable shall be manufactured with an "X"-shaped pair-divider along the center to maintain separation of individual pairs.
 3. Conductor diameters shall be 0.0224" \pm .0003" solid copper.
 4. Conductor insulation diameter shall be 0.039" \pm .0005" high performance fluoro-copolymer.
 5. Twist lay of each pair shall vary in a manner to optimize noise immunity and minimize crosstalk.
 6. A pair-divider along the cable center to maintain separation of individual pairs shall be optional.
 7. Outer jacket diameter shall be 0.220" \pm .008" low smoke PVC, with a nominal wall thickness of 0.015".
 8. Ripcord shall be directly underneath the outer jacket.
 9. UL, ETL, or CSA agency certification or verification markings shall be marked on the cable jacket according to the certifying agency's requirements.
 10. Color coding of the pairs shall be as follows:
 - a. Pair 1: White/Blue; Blue
 - b. Pair 2: White/Orange; Orange
 - c. Pair 3: White/Green; Green
 - d. Pair 4: White/Brown; Brown
 11. Cable shall be supplied in 1000 ft spools or 1000 ft Reelex boxes.
- D. Performance Requirements:
1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
 2. Cable shall exceed Category 6 transmission requirements specified in ANSI/TIA/EIA-568-B.2-1, and shall be tested to 500 MHz.
 3. Worst-case cable performance shall be +1.0 dB headroom over current TIA/EIA and ISO standards limits for NEXT loss and PSNEXT loss.
 4. Worst-case cable performance shall be +3.0 dB over current TIA/EIA and ISO standards limits for ELFEXT and PSELFEXT loss.
 5. Worst case electrical performance characteristics shall be as follows:
 - a. Characteristic Impedance: 100 \pm 15 (1.0-100 MHz) 100 \pm 20 (101-250 MHz)
 - b. Maximum Conductor Resistance: 9.38 /100 Meters @ 20°C
 - c. Maximum Resistance Unbalance: 3%
 - d. Maximum Mutual Capacitance: 5.6 nF/100 Meters @ 1 kHz
 - e. Maximum Capacitance Unbalance: 330 pF/100 Meters
 - f. Maximum Delay Skew: 45 ns/100 Meters
 6. The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.

7. Cable shall be UL and c(UL) listed.
8. Cable shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
9. Cable shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.
10. Cable shall exceed the requirements of TIA/TSB-155: 10 Gb/s Ethernet Operation over 55 Meters Channel Length.
11. Cable shall meet or exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-B.2-1 standard.
12. The 4-connector channel test configuration shall utilize Category 6 jacks and patch panels, with Category 6 patch cords, from the same manufacturer, with qualified Category 6 cable.
13. The 4-connector channel performance margins in the table below shall be guaranteed, provided the configuration satisfies requirement No. 12 above.

Electrical Parameter (1 - 250MHz)	Guaranteed Margins to Category 6 / Class E Channel Specifications
Insertion Loss	3 %
NEXT	4 dB
PSNEXT	5 dB
ELFEXT	4 dB
PSELFEXT	5 dB
Return Loss	2 dB

2.3 UTP PATCH CABLES FOR DATA

A. Manufacturers:

1. Hubbell Premise Wiring
2. ADC/Krone
3. The Seimon Company
4. Amp, Inc.

B. Basis of Design - Hubbell Premise Wiring NEXTSPEED Category 6 Patch cords

C. Design Requirements:

1. Category 6 patch cords shall be constructed with a smoke-colored polycarbonate plug having vertically staggered, trifurcated contacts, each having 50 micro-inches of gold plating.
2. Plug dimensions and function shall comply with FCC 47, Part 68.5.
3. Patch cords shall have a snag-less feature, integral to the strain relief boot on each end. Strain relief boot shall be molded PVC, and color matched to the cable jacket.
4. Patch cords shall be constructed with category 6 patch cable, with 24 AWG 7/32 tinned copper stranded conductors, each insulated with polyethylene, and overall jacket with UL flame-retardant PVC.
5. Patch cords shall be manufactured using a T568B wiring format, and shall function suitably for either T568A or T568B wiring schemes.
6. Patch cords shall be available in the following colors: black, blue, gray, yellow, orange, red, green, white, and purple. Custom lengths and colors shall be available with a delivery lead-time quotation.
7. Standard patch cord lengths shall range from 3 ft. to 20 ft.
8. Category 6 patch cords shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form, and function.

D. Performance Requirements:

1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
2. Category 6 patch cords shall be channel performance balanced with Hubbell category 6 jacks, patch panels, and punch-down blocks.

3. Category 6 patch cords shall meet or exceed Category 6 component transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C.2 standard.
4. The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
5. Patch cords shall be cUL and UL LISTED 1863.
6. Patch cords shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
7. Patch cords shall be third party verified, error-free Gigabit Ethernet performance to IEEE 802.3 standard.
8. Jacks shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 - 250 MHz when configured in a 4-connector channel.
9. Category 6 patch cords shall meet or exceed the 4-connector channel transmission performance requirements of Category 6, per ANSI/TIA/EIA-568-C.2 standard.
10. The 4-connector channel test configuration shall utilize Category 6 patch panels, blocks, and jacks, with Category 6 patch cords, all from the same manufacturer, with qualified Category 6 cable.
11. The 4-connector channel performance margins in the table below shall be guaranteed, provided the configuration satisfies requirement No. 9 above.
12. Category 6 patch cords shall meet the current draft 10 Gb/s transmission performance requirements of TSB-155, provided the configuration satisfies requirement No. 9 above.

ELECTRICAL PARAMETER (1 - 250 MHZ)	GUARANTEED MARGINS TO CATEGORY 6 / CLASS E CHANNEL SPECIFICATIONS
Insertion Loss	3 %
NEXT	4 dB
PSNEXT	5 dB
ELFEXT	4 dB
PSELFEXT	5 dB
Return Loss	2 dB

- E. Provide two patch cables for every connected patch panel ports.

2.4 TELEPHONE EQUIPMENT TELEPHONE BLOCKS

- A. Manufacturers:
1. Hubbell Premise Wiring
 2. ADC/Krone
 3. The Seimon Company
 4. Amp, Inc.
- B. Basis of Design - Hubbell Premise Wiring 110 Cross Connect
- C. Design Requirements:
1. Category 5e-110 wiring blocks shall be available in 50-pair, 100-pair and 300-pair capacities, with or without detachable standoff legs.
 2. Wiring blocks shall be available as kits that include wiring blocks, label strips, and the appropriate quantity of connecting blocks for termination to full capacity.
 3. Connecting blocks shall also be available separately.
 4. Connecting blocks shall accommodate a 5-pair punch-down tool designed specifically for the purpose of Category 5e termination.
 5. Wiring blocks and connecting blocks shall be constructed of UL94-V0 rated high-impact flame-retardant polycarbonate blend thermoplastic.
 6. Wiring blocks shall accept 26-22 AWG solid or stranded conductors
 7. Wiring blocks shall accept conductor insulation diameters of .050 in to .070 in maximum.

8. Wiring blocks and connecting blocks shall have a temperature rating of 14 °F to 140°F with up to 95% non-condensing humidity.
9. Wiring blocks shall have through-openings to permit rear cable entry and direct routing to each point of termination.
10. Connecting blocks shall connect to the wiring block with a locking force of 35 Lb minimum.
11. Connecting blocks shall withstand a minimum of 200 re-terminations without degradation to electrical or mechanical performance.
12. IDC contacts in the connecting blocks shall be a spring temper phosphor bronze alloy, .032" thickness, with 100 micro-inches minimum solder plate (60% tin/40% lead) at the wire contact area.
13. IDC contact termination towers on the connecting blocks shall have tapered pair-splitting features to aid wire insertion and minimize pair un-twist. IDC towers shall also have high-definition color-coding.

2.5 TELEPHONE CABLES

- A. Manufacturers:
 1. Belden
 2. Berk-Tek, Inc.
 3. Superior Essex Inc.
 4. Mohawk
 5. General
 6. Hitachi Cable
- B. Service Cable: Provided by Utility Company unless otherwise noted.
- C. Telephone High Pair Count Backbone Cables: Cables must meet or exceed Category 5E requirements.
 1. All high pair count cable shall conform to the requirements of ANSI/TIA/EIA-568-B.2 Commercial Building Telecommunications Cabling Standard.
 2. All high pair count cable shall consist of 24AWG thermoplastic insulated copper conductors that are formed into one or more units of unshielded twisted pairs.
 3. All high pair count cable shall be assembled into binder groups of 25 pairs or part thereof following the standard industry color code (ANSI/ICEA S-80-576).
 4. All high pair count cable shall be identified by distinctly colored binders and assembled to form the core.
 5. All high pair count cable shall have a sheath that consists of an overall thermoplastic jacket and may contain an underlying metallic shield and one or more layers of a dielectric material applied over the core.
 6. All high pair count cable shall be Plenum or Riser Rated in accordance with NEC Article 770, UL Subject 1666 and UL Subject 910.
- D. Telephone Workstation Cable: Provide UTP patch cables to match those used for data.

2.6 TELEPHONE CABLE CONNECTIONS

- A. Main Service Entrance: Provide Type '66' blocks, Category 5E, mounted on stand-off brackets from backboard with all cross-connect cables.
- B. Intermediate (Closet and/or Consolidation Point) Connections: Provide UTP rack mount patch panels to match those used for data.

2.7 MODULAR JACKS

- A. Manufacturers:

1. Hubbell Premise Wiring
2. ADC/Krone
3. The Seimon Company
4. Amp, Inc.

B. Basis of Design - Hubbell Premise Wiring NEXTSPEED Category 6 Jacks

C. Design Requirements:

1. Jacks shall be standard 8-position, RJ-45 style, un-keyed, FCC compliant.
2. Jacks shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
3. Each jack shall be single unit construction, with snap - fit to industry standard keystone opening (.760" x .580").
4. Jack housings shall be high impact UL 94 V-0 rated thermoplastic.
5. Jacks shall have a temperature rating of -10 °C (14°F) to 70°C (158 °F).
6. Jack housings shall fully encase and protect printed circuit boards and IDC fields.
7. Modular jack contacts shall accept a minimum of 2000 mating cycles without degradation of electrical or mechanical performance.
8. Jack contacts shall maintain a minimum deflection force of 100 grams while mated with an FCC-standard RJ-45 plug.
9. Jack contacts shall be constructed of Beryllium copper for maximum spring force and durability.
10. IDC contacts shall be Phosphor Bronze with 100 micro-inch tin lead 60/40 plating over nickel.
11. Jacks shall terminate 26-22 AWG solid or stranded conductors.
12. Jacks shall terminate insulated conductors with outside diameters up to .050".
13. Jacks shall not require special cords, specialty tools or special installation requirements.
14. Jacks shall be compatible with single conductor standard 110 impact termination tools.
15. Jacks shall be compatible with a 4-pair single punch impact tool designed specifically for the purpose.
16. Jacks shall include a translucent stuffer cap for wire retention and to permit visual inspection.
17. Stuffer cap shall have retention snaps to assure conductor strain relief.
18. Jacks shall accept FCC compliant 6 position plugs.
19. Jacks shall accept optional hinged dust covers.
20. Jacks shall be compatible with ANSI/TIA/EIA-606-A color code labeling.
21. Jacks shall accept snap-on icons for specific identification.
22. Jacks shall be available in various colors to meet specific customer applications.
23. Jacks shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
24. Category 6 jacks shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form, and function.

D. Performance Requirements:

1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
2. Category 6 jacks shall exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C.2, Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling.
3. Category 6 jacks shall exceed 10 Gb/s transmission requirements for connecting hardware, under the constraints of ANSI/TIA-TSB-155 (current draft).
4. The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
5. Jacks shall be UL LISTED 1863 and CSA certified.
6. Jacks shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.

7. Jacks shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.
8. Jacks shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 - 250 MHz when configured in a 4-connector channel.
9. Jacks shall exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-C.2 standard.
10. Jacks shall exceed the 4-connector Category channel performance requirements for 10 Gb/s transmission over Category 6, according to TIA/TSB-155 (current draft).
11. The 4-connector channel test configuration shall utilize Category 6 patch panels and Category 6 patch cords, from the same manufacturer, with qualified Category 6 cable.
12. The 4-connector Category 6 channel performance margins in the table below shall be guaranteed, provided the configuration satisfies requirement No. 11 above.

Electrical Parameter (1 - 250MHz)	Guaranteed Margins to Category 6 / Class E Channel Specifications
Insertion Loss	3 %
NEXT	4 dB
PSNEXT	5 dB
ELFEXT	4 dB
PSELFEXT	5 dB
Return Loss	2 dB

2.8 FACE PLATES AND UNLOADED MODULES

- A. Manufacturers:
 1. Hubbell Premise Wiring
 2. ADC/Krone
 3. The Seimon Company
 4. Amp, Inc.
- B. Basis of Design - Hubbell Premise Wiring IMF Series Modular Faceplates and Modules.
- C. Design Requirements:
 1. IMF Series Faceplates:
 - a. Faceplates shall be constructed of Stainless Steel.
 - b. Faceplates shall be 2.75" W x 4.5" H for single gang and 4.5" X 4.5" for double gang.
 - c. Faceplates shall accept modules loaded with Hubbell HXJ-series series jacks and Hubbell Snap-Fit fiber optic, audio, and video connectors for multimedia applications.
 - d. Two #6-32 pan head Phillips/slotted mounting screws shall be included with each single gang faceplate.
 - e. Four #6-32 pan head Phillips/slotted mounting screws shall be included with each double gang faceplate.
 - f. Faceplates shall be compatible with standard NEMA openings and boxes.
 - g. Faceplates shall be compatible with raceway fittings, surface mount boxes, service fittings, service poles, flush mount boxes and drywall rings.
 2. IMF Series Modules:
 - a. Faceplate Modules shall be constructed of high impact, UL94 V-0 rated thermoplastic.
 - b. Modules shall be compatible with IMF Series Faceplates, raceway, floor boxes, poke throughs, surface mount boxes, patch panels, furniture plates, and service poles.

- c. Modules shall snap firmly into front of faceplate and position flush to outer plate surface for field installation in any of the specified mounting hardware devices and media configurations.
- d. Single gang IMF Series Faceplate shall accept (3) 1U modules
- e. Double Gang IMF Series Faceplate shall accept (6) 1U modules.
- f. 1 Unit Modules shall be available for 1- and 2-Port Keystones, Blanks, and SVGA punched blanks to support the following connections per work area requirements.
 - 1) RJ-45 Category 6 jack per ANSI/TIA/EIA-568-C.2
 - 2) ST fiber optic connector per EIA/TIA-604-3
 - 3) SC fiber optic connector per EIA/TIA-604-3
 - 4) S-video Gold Jack
 - 5) RCA Gold Jack (color coded)
 - 6) BNC connector (straight mount)
 - 7) Gold F connector (straight mount)
 - 8) SVGA (female)
 - 9) 3.5 Mini Stereo Jack
 - 10) Gold Speaker Post
 - 11) USB connector
 - 12) Blank filler plate

2.9 FLOOR MOUNTED EQUIPMENT ENCLOSURE - CLOSED TYPE ENCLOSURE

- A. Manufacturers:
 - 1. Middle Atlantic Products
 - 2. Atlas Soundolier
 - 3. Ortronics
 - 4. Hoffman
- B. Basis of Design - Middle Atlantic Products
 - 1. Model: WRK-44-32
 - 2. Type: 19-inch gangable equipment rack
 - 3. Compliance:
 - a. EIA/TIA 310D
 - b. Seismic Certified: Seismic certified to 1997 UBC and 2001 CBC Seismic Zone 4 and 2000 IBC, 2003 IBC, 2002 ASCE Standard 7, and 2003 NFPA 5000 Seismic Use Group III lateral force requirements for protecting 900 pounds of essential equipment in upper floor installations when used with optional WRK-Z4 seismic floor anchor brackets with Ip value of 1.5.
 - 4. UL Listed: US
 - 5. Overall Dimensions:
 - a. Height: 83.13 inches
 - b. Width: 24.25 inches
 - c. Depth: 32.63 inches
 - 6. Useable Dimensions:
 - a. Height: 77.13 rackspaces
 - b. Depth: 30.75 inches
 - 7. Construction: Fully welded
 - 8. UL Listed Weight Capacity: 2,500 pounds (static load capacity is 10,000 lb)
 - 9. Materials:
 - a. Top and Bottom: 14-gauge steel
 - b. Horizontal Braces: 16-gauge steel welded to integral structural side panels of 16-gauge steel giving 1/8-inch thick structure
 - c. Rear Door: 18-gauge steel
 - 10. Finish of Structural Elements: Black textured powder coat
 - 11. Rackrail:
 - a. Two pairs of fully adjustable, 11-gauge steel rackrail with tapped 10-32 mounting holes in universal EIA spacing
 - b. Finish: Black e-coat
 - c. Rackspaces: Numbered
 - 12. Top and Bottom: Vertical slotted vent pattern

13. Removable Rear Knockout Panel:
 - a. 1/2-inch, 3/4-inch, 1-inch, and 1-1/2-inch electrical knockouts installed in top and bottom
 - b. 5/8-inch BNC knockouts for UHF/VHF antennas installed in top
14. Grounding and Bonding Stud: 1/4-20 by 1-inch threaded, installed in base, allows installation to conform to NEC

C. Provide the following accessories for **ALL** racks:

1. Caster Base:
 - a. Standard Caster Base, Model CBS-WRK-32:
 - 1) Adds 1 inch to overall height
 - 2) Total Weight Capacity of 4 Casters: 1,300 pounds
 - 3) UL Listed: US and Canada
 - b. Fine-Floor-Friendly Caster Base, Model CBS-WRK-32R:
 - 1) Adds 1 inch to overall height
 - 2) Total Weight Capacity of 4 Casters: 700 pounds
2. Rail Bracket Adapters, Model RBA-W44-1:
 - a. Allow for mounting of blank or other panels vertically between rackrail brackets
 - b. 44 space enclosures
3. Lacer Strip: 11-gauge steel, heavily perforated, 77 inches long, Model LACE-44-OWP
4. Additional Rail Kit: 11-gauge steel, 10-32 threaded, in pairs, includes hardware, Model WRK-RR-44
5. Seismic compliancy floor anchor kit
6. Wrinkle touch-up paint
7. Ganging hardware
8. Copper buss bar
9. Document pocket
10. Leveling Feet:
 - a. Isolated or Non-isolated
 - b. 3/8-inch threaded steel, adjustable from top or bottom
 - c. Adds 1/4 inch to 1 inch to rack overall height
11. Inner platform base, Model BS-WRK-32
12. All equipment mounting hardware required
13. Blank and vented panels to fill rack
14. Adjustable telescoping rackshelf, Model VSA-2744.
15. Heavy Duty Drawer, Model D3

2.10 BACKBOARDS

- A. AC grade southern yellow pine or fir plywood with exterior glue, 3/4" thick, size as shown or required.
- B. Paint with 1 coat of exterior wood primer both faces and all edges and 1 coat of light gray semi-gloss enamel on the front face only.

2.11 HORIZONTAL WIRE MANAGEMENT

- A. Manufacturers:
 1. Middle Atlantic Products
 2. Hubbell Premise Wiring
 3. Homaco
 4. Hoffman
- B. Basis of Design - Middle Atlantic Products Horizontal Cable Managers
- C. Design Requirements:
 1. Horizontal cable management panel shall be all steel with black powdercoat finish.

2. Horizontal cable management panel shall feature (5) cable management rings on front and back constructed of flat steel for maximum cable support.
3. Horizontal cable management duct (Models HHCM-1 or HHCM-2) shall feature hinged front steel covers.
4. Black powder coating shall comply with all applicable ASTM standards for exposed metal, and resistance to flaking, cracking, or chipping.

2.12 WALL MOUNTED STAND-OFF BRACKETS

- A. Manufacturers:
 1. Middle Atlantic Products
 2. Hubbell Premise Wiring
 3. Homaco
 4. Hoffman
- B. Basis of Design: Middle Atlantic Products HPM Series Mounts.
- C. Heavy duty two vertical steel only spaced to mount 19" wide panels and chasses constructed to EIA-310-D dimensions with base plate and bracing.
 1. Universal keyhole mounting for left or right swing
 2. Mounting holes must provide options to mount directly to racks or walls
- D. Mounting Rails: 2 drilled and tapped to EIA-310-D dimensions.
 1. 10-32 rack screws included
- E. Mounting Space: Racks units as required plus 20% spare. Provide multiple brackets totaling the indicated number of units hinged for future termination without dismounting patch panel.
- F. Provide the following Accessories:
 1. Optional lid to protect equipment from dust, Model HPM-LID

2.13 LIGHTNING PROTECTION

- A. Manufacturers:
 1. Circa
 2. Siecor
 3. ITW Linx
- B. Basis of Design - Circa Building Entrance Terminals:
 1. 1880 Series for 110 punchdown
 2. 1890 Series for 66 punchdown
- C. Design Requirements:
 1. Protection shall be available in 25 pair, 50 pair or 100 pair
 2. Equipped with an internal fuse link
 3. Equipped with a removable splice chamber should the terminal fuse within a multiple configuration
 4. Stackable to allow for future service expansion
 5. External ground connectors accept 6-14 AWG ground wire
 6. Accommodates industry standard 5 pin protection module
 7. Designed to exceed the requirements set forth in UL 497
- D. Provide protection for number of pair in service cable entering premises.
- E. Provide on each cable or pair entering or leaving the premises.

2.14 LABELING

- A. Identify system components complying with applicable requirements in Section 260553
- B. System: Use a unique, 3 syllable alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.
 - 1. First syllable identifies and locates wiring closet or equipment room where cable originates.
 - 2. Second syllable identifies and locates cross-connect or patch-panel field in which cable terminates.
 - 3. Third syllable designates type of media (copper or fiber) and position occupied by cable pairs or fibers in the field.
 - 4. Example: A2-2-C46
- C. Workstation: Label cables within outlet boxes.
- D. Equipment Racks, cabinets and Backboards: Label each unit and field within that unit.
- E. Within Connector Fields, in IDF/MDF Rooms and Consolidation Points: Label each connector and each discrete unit of cable terminating and connecting hardware. Where similar jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.
- F. Cables, General: Label each cable within 4" of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
- G. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 100 feet.
- H. Cable Schedule: Post in prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Provide electronic copy of final comprehensive schedules for project, in software and format selected by Owner.
- I. Provide engraved nameplates on all equipment racks, cabinets and backboards to identify the service (telephone, video, data, etc.) and the unit name (IDF #6, Backboard #3, MC #2 etc.)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cable. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install all cables in accordance with equipment manufacturers instructions, and with recognized industry practices, to ensure the installation complies with requirements of the NEC, ANSI/TIA/EIA-568-C.1 Commercial Building

- B. Install all cables only when the temperature is between 32°F to 122°F.
- C. Wiring Method: Wiring shall be installed in EMT conduit within walls and above inaccessible ceilings. Wiring shall be installed in cable tray where it is present. Wiring installed above accessible ceilings between ceiling mounted devices or conduit stub-ups and the cable tray shall be exposed and supported by J-hooks, spaced a maximum of 5'-0" on center, with minimum 1" flat bearing surface. Provide conduit sleeves, bushings and fireproofing through all wall penetrations. All wiring not in EMT conduit shall be kept a minimum of 6" away from all lighting fixtures, motors, and transformers. Cables cannot be ty-wrapped or stapled to ceiling or structural supports, conduit, or other items.
- D. Test each cable as detailed in specification. Include patch cord in test channel.
- E. Identify all cables with a neatly typed label as detailed in specification.
- F. Provide horizontal and vertical cable management in all racks, on all backboards and any other location cabling is not routed in conduit or cable tray. Size cable management for 50% additional cables.
- G. For buildings with floors in excess of two, provide a 2' diameter service loop (with 3 loops) in all between-floor fiber optic cables. Locate one service loop in ceiling cavities of each floor above the lowest floor for future changes/upgrades. Neatly cable tie service loop to structure or cable tray to prevent susceptibility to damage.
- H. UTP Cable Length:
 - 1. Maximum installed length of each UTP cable between closet and workstation outlet is to be 90 meters (295 feet). Ensure lengths are within specification prior to installation. Contact Engineer for procedure in the event of excessive distances prior to installation.
 - 2. Minimum length shall be 15 meters (49 feet). Provide service loop as required to increase length on short runs.
- I. Install cable without damaging conductors, shield or jacket, do not use unjacketed pairs for jumpers.
- J. Do not bend cable in handling or in installing to smaller radii than minimums recommended by manufacturer.
- K. No splicing is permitted for UTP and fiber optic cables. Cables must be continuous between termination points. Make splices, taps and terminations only at indicated outlets, terminals, cross-connect and patch panels.
- L. Provide at least 10' of cable slack at MDF or IDF closet. This slack may be stored in the cable tray or a cable management device behind the MDF/IDF.
- M. Provide 2' diameter in service loops or use figure-8 or serpentine.
- N. Provide at least 1' of slack at each workstation outlet. This slack may be coiled within device box observing bend radius minimum or within accessible ceiling space using approved J-hook support.
- O. Remove jacket of cable and untwist individual UTP conductors the minimum amounts required to terminate on jacks and patch panels.
- P. Cable fill in conduit is 40% maximum as follows:
 - 1. 3/4" - 4 UTP Cables

2. 1" - 7 UTP Cables
 3. 1 1/4" - 12 UTP Cables
 4. 1-1/2" - 16 UTP Cables
 5. 2" - 22 UTP Cables
 6. 2-1/2" - 36 UTP Cables
 7. 3" - 50 UTP Cables
 8. 3-1/2" - Not recommended
 9. 4" - Not recommended
 10. Provide larger conduits than recommended for cable fill if indicated on the Drawings.
- Q. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
1. Pull cables simultaneously if more than one is being installed in the same raceway.
 2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
 3. Use pulling means, including fish tape, cable, rope and basket-weave wire/cable grips that will not damage media or raceway.
- R. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.
- S. Secure and support cable at intervals not exceeding 5'-0" and not more than 1'-0" from cabinets, boxes, fittings, outlets, racks, frames and terminals.
- T. Wiring within IDF/MDF and Enclosures: Provide adequate length of conductors. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
- U. Separation of Wires: Comply with EIA/TIA-569 rules for separating unshielded copper telecommunications equipment cables from potential EMI sources, including electrical power lines and equipment.
- V. Install a 1 rack unit blank filler plate between patch panels which contain more than 12 jacks.
- W. Provide blank filler plates as required to fill rack.
- X. Support raceways, cabinets and all other equipment in accordance with manufacturer's instructions.
- Y. Install backboards and cabinets plumb, and attach securely to building wall at each corner and additional as necessary to obtain a firm mounting.
- Z. Provide pullwire in each empty telecommunications conduit.
- AA. Install fiber optic cables in innerduct when not installed in cable tray. Use armored fiber as an alternate to innerduct where equal protection is afforded.
- BB. Install fiber optic cables in innerduct inside conduit. Provide multiple innerducts in larger conduits.
- CC. Support innerduct at manufacturers recommended intervals using manufacturer approved methods.
- DD. Provide Type 110 blocks for interconnections within the building. Use 66 blocks for terminations of cables entering or leaving the premises.
- EE. Provide full assembly of all racks, equipment enclosures, cabinets and file servers with all accessories installed.

3.3 GROUNDING

- A. Comply with Section 260526 and applicable details on plans.
- B. Provide connections to the main ground bus on all backboards, telephone line protectors, IDF Racks and MDF Racks in the project. Connect to ground buses with cables per Specification Section 260526 and applicable details on plans.

3.4 FINAL TESTING AND INSPECTION

- A. Provide testing in accordance with ANSI/TIA/EIA-568-C.1.
- B. Cable Test: Provide prior to substantial completion, a Performance Evaluation Report, which will contain the following:
 - 1. Cable Test: List by cable number each UTP and Fiber Optic Cable in the project, which details:
 - a. Fiber Optic Cables:
 - 1) Cable ID Number
 - 2) Final measured attenuation in dB/Km
 - 3) List any discrepancies with the fiber installation (bad terminations, faulty labeling, etc.)
 - b. UTP Cables:
 - 1) Cable ID Number
 - 2) List continuity, reversal, open, shorts and miswires
 - 3) Category performance
 - 4) List other discrepancies with the UTP installation (bad terminations, faulty labeling, etc).
 - 5) Tester printout for each cable.
 - 2. Test Method: All fiber cabling to be tested as follows: Fiber Testing: Cable to be factory pre-tested on a reel basis for all fiber on this project. The attenuation in dB/Km to be recorded in Final Test Report. Contractor must test each fiber after installation using Power Meter. A dB Printout, end to end with connectors attached to be made and provided as part of the "Performance Evaluation Report". Traces must depict actual fiber loss (dB/Km), fiber length (ft.) and any fiber irregularities. Runs over 1,000' must be tested using an optical time domain refractometer (OTDR). Test horizontal cables when installed and terminated as follows:
 - a. Both Wavelengths
 - b. One Direction
 - c. Link Loss <8.5 dB, 200 meters
 - d. Test centralized cables from utility entrances (typically single mode) as follows:
 - 1) One Wavelength
 - 2) One Direction
 - 3) Link Loss <3.3 dB for 300 meters.
 - 3. UTP Cable Testing: Test each cable pair of each cable after installation for Specified Category performance. Conduct test with a tester designed for testing above cable (with RJ-45 jacks installed) from each data outlet to associated patch cord through +0 panel jack (Channel). Provide printout for each test as part of the Performance Evaluation Report. Minimum performance categories for report are to be as follows:
 - a. Wire Map/Continuity
 - b. Length
 - c. Near End Crosstalk (pair to pair) NEXT
 - d. Near End Crosstalk (power sum) PSNEXT
 - e. Equal Level Far-End Crosstalk Loss (pair to pair) ELFEXT
 - f. Equal Level Far-End Crosstalk Loss (power sum) PSELFEXT
 - g. Return Loss
 - h. Attenuation
 - i. Propagation Delay
 - j. Delay Skew
 - k. PSACR (Powersum Attenuation - Crosstalk Ratio)

4. System Performance Report: Provide a narrative detailing the system as a whole, in regards to the quality of installation and any discrepancies affecting performance. This narrative to indicate a summary of the above Cable Test, as well as an accurate summary of specified Category performance as well as capability of the cabling system to perform at specified Category bandwidth. Indicate-steps necessary to correct all deficiencies in the cable installation to enable specified Category performance.

3.5 WARRANTY

- A. The installation shall be provided with a minimum 25 year warranty for strict compliance with the performance requirements of ANSI/TIA/EIA-568-C.1 to support and conform to ANSI/TIA/EIA-568-C.1 specifications covering any current or future application which supports transmission over a properly constructed horizontal cabling system premises network which meets the channel performance as described in ANSI/TIA/EIA-568-C.2.

END OF SECTION 271400

SECTION 281300

ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Card Access System
- B. Accessories

1.2 USGBC LEED CERTIFICATION

- A. The contractor, supplier, manufacturer, sub-contractor, and/or service provider shall understand that this project will be seeking the Leadership in Energy and Environmental Design (LEED) Silver Certification administrated by the United States Green Building Council (USGBC). Documentation and validation of materials, sources, and services provided for this work will be required from the respective entities, and the responsibility of the prime contractor.

1.3 REGULATORY REQUIREMENTS

- A. System: UL Listed
- B. Conform to National Electric Code

1.4 QUALITY ASSURANCE

- A. Manufacturers: Companies with headquarters in the United States specializing in Access Control Systems for at least five years.

1.5 SUBMITTALS

- A. Submittal Procedures: Submittal requirements per specifications.
- B. Shop Drawings: Indicate layout, wiring diagrams and dimensions
- C. Product Data: Submit data sheets for each item of equipment
- D. Manufacturer's Installation Instructions: Indicate installation instructions
- E. Manufacturer's Certificate: Certify that the system meets or exceeds specified requirements

1.6 CLOSE-OUT SUBMITTALS

- A. Execution Requirements: Project record document procedures per specifications.
- B. As-built drawings to indicate actual location of equipment and devices

ACCESS CONTROL SYSTEM

281300-1

13-0303.00 Lebanon Ridge Oral Health

- C. Operation and Maintenance Data: Include operating instructions and maintenance and repair instructions

1.7 DELIVERY, STORAGE AND HANDLING

- A. Product Requirements: Product delivery, storage, protection and handling per specification.

1.8 WARRANTY

- A. Execution Requirements: Provide warranty per specifications.

1.9 SYSTEM DESCRIPTION

- A. Provide a complete and operational Access Control system with the performance requirements listed in this specification. System shall include any necessary accessories not listed to make the system completely functional. Provide system with the most current version of firmware.
- B. System shall provide access to the building through the use of proximity card readers. The system shall permit and restrict access to the building on a 24-hour basis. Card readers shall be provided in quantities as indicated on the contract drawings.
- C. System shall utilize non-proprietary coding of proximity cards and be capable of reading magnetic swipe, bar code, Wiegand output and optical or biometric type access cards or devices.
- D. Installer shall coordinate with the end-user for programming information and training. The system shall be provided with 100 user cards initially.
- E. System equipment shall be equipped with surge protection devices as required to prevent damage to electrical or electronic circuiting and devices.
- F. System shall be interconnected with the building fire alarm system to unlock doors as required by code during an alarm condition.
- G. All door hardware, such as: magnetic locks, electric strikes, request-to-exit devices, etc. are to be provided by the Door Hardware provider/General contractor. Coordinate with the provider prior to installation to ensure proper system functions.

1.10 QUALIFICATIONS

- A. Manufacturer: Equipment manufactured by MAXxess - Anaheim, California.
- B. Pre-approved vendor - Sage Technology Solutions, Inc. - Charlie Mowrer - 717-653-6641.
- C. Supplier: The supplier must have a minimum of five years' experience in the design and installation of systems equal in size and type required by this project. The supplier must maintain a local service organization within a fifty (50) mile radius of the installation with spare service replacement boards, components and accessories whose local personnel can provide five

reference installation sites which they have installed for each item of equipment in each system listed here-in.

- D. The supplier must be the authorized representative of the equipment manufacturer supplied and have full-time technicians trained and certified in the installation and service of the equipment supplied. The supplier must supply with the shop drawing submittal a list of five installations (along with contact personnel) of the proposed control equipment provisioned by the proposed installation team.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. The Access Control and Security Management system (A/SM) shall consist of an Access/Security management computer, A/SM software, card readers, card reader processors (BLP's) and Intelligent Area Controllers
- B. The A/SM computer shall support all system monitoring and administrative functions. The computer may reside anywhere on the communications circuit or interface via a LAN/WAN connection. To ensure the secure transfer and storage of data, all system modules connected to the network, including the database, shall be encrypted. The A/SM system shall deploy a Symmetric Key system of encryption with a Block Cipher using a minimum of a 128-bit Key. The type of encryption deployed shall meet U.S. Government's Advanced Encryption Standard (AES) and shall be of the Rijndael or 3DES methodology.
- C. All operator interfaces with the system shall be through the A/SM computer. System Display terminals shall display real time system messages, data files and records, operator instructions, data programming information and custom graphic illustrations. The A/SM software shall be compatible with Windows split-screen and multi-screen functionality. System keyboard(s) shall provide for entry of operator commands and acknowledgements and system database queries.
- D. The A/SM computer shall not be proprietary to the system manufacturer. It shall be of adequate size and processing power to support the following minimum capacities:
 - 1. Workstations: 1 expandable to 50 including the host computer
 - 2. Printers: 2 expandable to 10
 - 3. Card readers: Unlimited
 - 4. Alarm inputs: Unlimited
 - 5. Control output points: Unlimited
 - 6. Cards: up to 100,000
- E. The A/SM system shall incorporate distributed processing. Access Control Units (ACU's) also classified as Remote Access Memory Modules (RAMM) shall provide an intelligent interface between point monitoring devices classified as Card Reader Processors (BLP'S), card readers and the A/SM computer.
- F. Point monitoring and access control messages from field-installed devices shall be collected by the ACU's and transmitted to the A/SM computer.
- G. Communications between the A/SM computer and the workstations shall be over a contractor-provided communications circuit and shall be fully supervised.

- H. The A/SM system shall be capable of granting access through controlled doors with the use of the following reader technologies:
 - 1. Proximity (125kHz or 13.56 MHz)
 - 2. Encrypted barcode
 - 3. Magnetic stripe
 - 4. Keypad
 - 5. Card and pin
 - 6. Biometric devices
 - 7. Smart cards

- I. The A/SM system shall be capable of monitoring the alarm input status of the following equipment and systems:
 - 1. Access Control: Card reader controlled door held open alarm, intrusion alarms and invalid card use alarms; annunciated as separate alarms.
 - 2. Door Position Switches: Normally closed contacts from concealed door position switches, surface mounted door position switches or overhead door position switches to monitor the secure status of each door in the system.
 - 3. Dual technology Motion Sensors: A normally closed contact from a dual technology motion sensor for remote monitoring of the secure status of areas.
 - 4. Glass break detectors: A normally closed contact from a glass break sensor for remote monitoring of the secure status of certain windows.
 - 5. Photoelectric Motion Sensors: A normally closed contact from a photoelectric motion sensor for remote monitoring of the secure status of areas.
 - 6. Tamper Switches: Normally closed contacts from tamper switches for remote monitoring of the secure status of all ACU's, power supplies and power distribution units.

- J. Access Control Units (ACU's)
 - 1. The ACU's shall be capable of collecting alarm input point status and card reader data, prioritizing the information and transmitting that data back to the AS/M computer. ACU's shall support a minimum of 20 card readers through the use of 2-door modules called Card Reader Processors (BLP's)
 - 2. The ACU shall incorporate Flash ROM to allow for efficient firmware updates from the host software and/or remotely from the A/SM system manufacturer.
 - 3. The ACU shall be capable of providing control output points initialized by alarm events, remotely controlled by the A/SM computer or by software time schedule.
 - 4. The ACU shall have memory and logic circuits as required to insure continued operation of connected devices without degradation in system security in the event that communication with the A/SM computer is interrupted.
 - 5. The ACU power supply shall provide four hours of battery back up to provide continuous operation during power failure. Weatherproof Nema 4 enclosures will be provided to house power supplies in all outdoor applications.
 - 6. ACU's shall be capable of communicating via RS-232, RS-485, fiber optic and CAT5 Ethernet with no additional communication converters except telephone modems where communications via existing public telephone lines are used. All communications shall be fully supervised.

2.2 SOFTWARE REQUIREMENTS

A. General:

1. The A/SM system software shall be designed to support Multi-tasking/multi-user applications. Independent, simultaneous performance of multiple system functions from system workstations or ACU's shall not cause and appreciable reduction in system performance or response time.
2. The system shall allow the operator to switch between the system software and other applications while the system software is running. Switching between applications shall be accomplished through the use of hot keys on system keyboard or by computer mouse. The system shall be configured such that only an operator logged in at the "System Administrator" level can allow configuration to minimize the system software or switch to other applications. If an alarm condition occurs while the system software is minimized, the system shall be maximized, become the active window in the foreground and display the map and associated map icon in alarm.
3. The A/SM system software shall be menu driven with the help screens to assist the operator. The A/SM system keyboard shall be equipped with function keys and a computer mouse to call up help screens and standard operator tasks such as arm/disarm, lock/unlock, card holder review, alarm acknowledge, map call up, etc. with a single keystroke or click of the mouse button.
4. The A/SM system software shall include embedded audio-visual help files for all standard operator functions. These audio-visual files will graphically "show and tell" the system operator how to accomplish basic system management and configuration functions as to "How to add a Cardholder" or "How to run a Report" or "How to Acknowledge an Alarm," etc such that the operator can accomplish basic system navigation and configuration tasks without any previous experience with the A/SM system.
5. The A/SM system shall provide for an unlimited number of password restricted operator access levels. This feature shall restrict access to sensitive programming functions to authorized personnel only. The highest-level password shall have access to all system databases and functions. Each password shall be individually programmable to restrict operator access to programming and operator function, commands, and database access and alarm point and control point functions. The system shall limit the ability to upgrade or update the software to the system master only. In addition the system shall allow for the implementation of strong passwords for increased system security for log-on and authentication. Strong passwords shall be a minimum of six (6) characters long using at least three of the following four classes: English uppercase letters, English lower case letters, Arabic numerals and non-alphanumeric special characters.
6. The AS/M system shall provide and audit feature to maintain an historical record of what changes were made and who made them.
7. The A/SM system must utilize 128-bit Rijndael (NSA Standard) encrypted data communication between all networked area controller and terminals. Additionally, the communication path - including, fiber, RS-485, dial-up and network connections - between the host PC and area controllers will also utilize 128-bit encryption.
8. The software must include and embedded training program that utilizes video/sound AVI files to train operators how to perform common software tasks. The program must have the ability to stop/rewind/pause during training presentations.

9. The software must have the ability to generate and send emails based on alarm and or normal access activity. Those transmissions must include: time, date, user, activity and location.
10. The software will include a voice synthesizer that reads event lines.
11. The software must include a universal communication gateway interface to third party devices or systems. The serial integration of the third party system should allow for inputs and commands and bi-directional control of the external system via unique icons on graphical floor plans. This software module resides on the main system control software server and it is capable of up to 100 external third party interfaces.
12. The software must have the capability of database partitioning.
13. Graphical maps
 - a. The A/SM system shall provide for map graphics that graphically depict A/SM system status. Icons placed on graphical backgrounds shall be used to indicate the real time status of each system connection including card reader connections, alarm inputs, control point outputs, communication connections, etc.
 - b. The icon of the device in alarm shall be differentiated from other device symbols by enhancement, color change and /or flashing. Different enhancements shall indicate normal, alarm, trouble, time schedule shunt, manual shunt and other status conditions provided by the system.
 - c. The A/SM system shall be capable of being configured to automatically call up a graphical map upon system-generated alarms without an operator request.
 - d. The A/SM system shall provide for the import of graphics generated by other drawing programs.
14. Upon operator acknowledgement of alarm, the A/SM system shall display up to one section of text for each alarm. The first line shall be the alarm message and the additional space shall be used for a user programmable response message or instruction list unique to each alarm point.
15. The A/SM system shall provide for a status screen on the A/SM system CRT/LCD. An operator shall manually display the status screen any time during a session with a mouse click. The operator shall be able to select any group to view in more detail. The status screen shall display the following:
 - a. A complete list of all alarm points displaying the status of each alarm point.
 - b. A complete list of all doors displaying the status of each door.
 - c. A complete list of all outputs displaying the status of each output.
 - d. A complete list of all alarm zones displaying the status of each alarm zone.
16. Multiple alarms may be queued in their order of priority.
17. In addition to the visual annunciation of alarms specified, the A/SM system shall be capable of providing customized audible voice annunciation and action taking messages for each alarm input. An integral word recognition/voice synthesizer software module shall be included with the A/SM control software.
18. The A/SM software shall be capable of sending email messages to designated recipients upon a change of status of any of the alarm inputs and systems designated for monitoring.
19. The A/SM computer and event printer shall display and record the alarm message in real time including: the time, date, location, point description, event type and point status of each point transaction.

20. The A/SM system database program shall be capable of printing, displaying and archiving of all point transactions. The A/SM system shall allow the owner to over-ride this mode on a point-by-point basis.
21. The operator shall be able to verify current status of any point in the system and change any of the programmable point descriptors via the A/SM computer.
22. All software applications shall be specifically designed for the security and access control industry. A current high-level language shall have been used to develop all application programs.
23. The A/SM system shall include a schedule program that will allow the owner to automatically schedule events, such as report printing, output commands, door access, alarm access, etc. on a time/day programmable basis up to one year in advance.

2.3 ACCESS CONTROL

- A. The A/SM system shall provide control point outputs for lock power control activated by card reader, wireless control, A/SM computer keyboard or time schedule.
- B. All alarm control points as well as card reader inputs shall be capable of independent time schedule via software controls from the A/SM computer.
- C. The A/SM system shall provide for controlled access through card reader controlled doors based on the card users access levels. An access level shall define a door or group of doors accessible by a cardholder during a certain time period(s). Time periods shall include both authorized days and hours.
- D. The A/SM system shall provide for automatic card expiration by specified time and date.
- E. The A/SM shall store in memory every card access transaction, describing the nature of the transaction, time, date, reader location, and cardholder name and validity status.
- F. The A/SM system shall provide for alarm indication at the A/SM computer for unauthorized reader use attempts. Unauthorized reader use alarms shall be user selectable on a reader-by-reader basis. When configured in card and PIN mode the system shall automatically invalidate the badge after five consecutive invalid PIN attempts.
- G. The A/SM system shall provide CRT/LCD screen display and event printing of card use (all transactions or violations only, by card and/or by reader).
- H. The A/SM system shall provide momentary or maintained release of card reader controlled door locks via the A/SM computer keyboard.
- I. The A/SM system shall provide for user programming of the following data for each card:
 1. Card number (internal and hot stamp)
 2. Access level
 3. Authorized areas
 4. Effective date
 5. Expiration date
 6. Cardholder name
 7. Cardholder social security number (or equivalent ID number)

8. Employee status (active, retired, temporary, etc.)
9. Cardholder department name
10. Cardholder automotive license number
11. Cardholder home telephone number
12. Cardholder business phone number
13. Company name (if other than system owner)
14. Seventy (70) user definable fields

J. The A/SM system shall allow cardholder tracking by individual cards.

K. The A/SM system cardholder database shall allow for the import of cardholder data with ASCII files created from other databases or system

2.4 DATABASE QUERIES, EDITING AND PRINTING

A. The A/SM system shall provide for database queries, database editing and report printing via user definable parameters. The A/SM system shall be capable of printing requested queries and reports to the A/SM computer screen or its associated report printer. In addition, the A/SM system shall be capable of conducting a file search by field or combination of user definable fields. Upon the users request, searched and sorted files shall be capable of being printed in the order dictated by the user, i.e. alphabetically by physical characteristics such as height, hair color, eye color, etc.

B. The A/SM system shall provide for database queries on any field or combination of fields in the system databases. The A/SM system shall allow the operator to edit the queried records after the search.

C. Database operations that require a large number of temporary files to be generated as a result of database queries (i.e. SQL) shall not affect any aspect of overall system performance. The A/SM system processor and Ram capacity shall be sized to efficiently process and store specified minimum number of A/SM transactions, while maintaining the specified A/SM system transaction speed when operating in a database query mode.

D. The event printer shall record in real time with designations all or owner selected A/SM system activities, including but not limited to:

1. Log on and Log off denoting operator's ID
2. Program changes
3. Alarm conditions
4. Alarm resets
5. Alarm acknowledge
6. Control commands
7. Selective card tracking
8. Invalid card use
9. Selective reader tracking
10. Visitor card use

E. The A/SM system shall provide for report printing and/or display of any group of events within any selectable time period. The report printer shall be capable of producing a hard copy of any report that the system may generate. Reports shall include historical events defined by any combination of the following events:

1. All events
2. Location
3. Point number

4. Event type (i.e. intrusion, door open, etc.)
 5. Point status (i.e. off, alarm, normal, shunted, etc.)
 6. Management reports of transactions history by card number, cardholder data, reader number, time period or invalid attempts.
 7. Audit trail reports
- F. The A/SM system shall incorporate a minimum of 100 preprogrammed reports. Such preprogrammed reports shall be capable of "point and click" selections at the A/SM computer.
- G. The A/SM system shall provide for display and or reporting of user generated custom reports. Sorts and queries for custom reports shall be by any field or combination of fields of the cardholder, card reader, alarm input point and control output point databases. Custom report generators shall be user friendly and shall not require the knowledge of high level programming languages.
- H. The A/SM system shall provide the ability for the emailing of report outputs.
- I. The A/SM system shall allow the exporting of report outputs to a delimited text file or HTML file.
- J. The A/SM system shall allow the exporting of report outputs directly to another database.
- K. The A/SM system shall have a universal interface/gateway capability to integrate third party devices or systems. This universal gateway capability will reside on the A/SM computer and will provide a bi-directional serial interface (I/F) library of both generic and application specific integration. Each I/F library shall allow for inputs and commands, as well as bi-directional control of external systems. The universal gateway will operate as a secure multi-tasking service of the A/SM system so A/SM throughput and operations are intact and system resources are properly administered.

PART 3 - EQUIPMENT

3.1 ACCESS/SECURITY MANAGEMENT SYSTEM SOFTWARE

- A. The A/SM software shall comply with all of the functional requirements as outlined under this specification. The software shall be eAXxess Security Management Software package from MAXxess - Part number 7300-100.

3.2 A/SM COMPUTER

- A. The A/SM computer shall initially be provided with sufficient processing capacity, memory and hard disk space to accommodate the A/SM system minimum requirements as defined within this specification.
- B. The A/SM computer and dedicated security system communications circuit shall be configured such that a severed or damaged network communications cable or communications failure with one or more of the workstations shall not cause failure of the entire network.

- C. The A/SM shall communicate with the system workstations, printer and ACU's via EIA standard ports.
- D. All wiring between the A/SM computer and the ACU's shall be supervised by poll response technique such that any loss of communication shall cause a supervisory alarm at the system terminal.
- E. The A/SM computer shall be capable of being restored to full operation from a complete shutdown within five minutes. The A/SM shall be self-booting upon power restore.
- F. The A/SM computer shall annunciate all component, communications and power failure and supervisory alarms anywhere within the A/SM system.
- G. The A/SM computer shall provide for non-volatile storage of the operating system program, user database and event data files. A hard disk shall be provided as the primary mass memory storage device and a CD-ROM shall be provided for downloading operating system software.
- H. The A/SM computer shall continuously maintain a database record of all A/SM system transactions for a minimum of 200,000 transactions. The A/SM system shall prompt the operator to back up the database as the memory becomes filled. The A/SM system shall automatically prompt memory capacity warnings.
- I. The A/SM computer shall meet the following minimum specifications:
 - 1. Processor: Pentium 4 2.0 GHz
 - 2. Operating system Microsoft Windows XP Pro
 - 3. Database I/F Microsoft SQL 2005 Express ODBC/SQL compliant
 - 4. Memory 2 GB DDRAM
 - 5. Hard disk size 500 GB
 - 6. Display monitor 17" color flat panel screen
 - 7. Resolution 1280 x 1024 pixels
 - 8. Keyboard/mouse standard
- J. Install Software on owner furnished Computer meeting the above specs.

3.3 SINGLE READER AREA CONTROLLER

- A. The Area Controller shall be n IP-based unit that provides complete local distributed processing based on local storage of all hardware operating parameters and cardholder record details of the Access Control System. The Area Controller shall be connected to Reader interface modules using RS-485 communications or via TCP/IP Ethernet network connection.
- B. The Area Controller shall have onboard support for one (1) or two (2) Card readers supporting a single door, as well as two (2) programmable inputs and two (2) relay outputs.
- C. The Area Controller shall be Power over Ethernet (PoE) capable
- D. Provide one (1) MAXxess eMAX-EP1501 Area controller.

3.4 READER INTERFACE MODULE

- A. The Local Controller shall be an intelligent controller that contains all configurations and cardholder details for the SMS system. The LAC is an IP-based, network ready interface panel that is low cost and high-performing. The unit is easy to install and provides the I/O needed for controlling one or two doors with power over Ethernet for complete door functionality. The unit shall have four (4) inputs and (2) outputs. It shall control two (2) doors. The unit shall be PoE compliant.
- B. Provide the MAXxess eMAX-MR51e with enclosure. Connect the unit to the network via Category 6 cable. Unit must have a static IP address.

3.5 WALL MOUNTED PROXIMITY READER

- A. The wall mounted proximity card reader shall be proximity technology and shall read encoded data from access cards and transmit the data through the BLP to the A/SM.
- B. A two color LED on the Face of the wall mounted proximity card reader and audible tone shall indicate authorized and unauthorized reader uses.
- C. The wall mounted proximity card reader shall be capable of being mounted directly to a metal surface.
- D. The wall mounted proximity card reader and bit pattern shall not be proprietary to a single manufacturer.
- E. Provide the manufacturer recommended power supply for the wall mounted proximity card reader. The power supply shall conform to UL Class 2 power limit.
- F. The wall mounted proximity card reader shall have a minimum read range of 4 inches for door applications.
- G. The Wall Mounted proximity Card Reader shall be the HID 5395 Thinline II reader. Provide quantities as shown on contract documents.

3.6 ACCESS CARDS

- A. The access card shall have only a hot stamp card number visible on the card and shall not indicate the contractor or the manufacturer name and/or logo.
- B. Provide (100) proximity access cards compatible with the specified reader technology.

3.7 DOOR POSITION CONTACTS

- A. Surface mounted or recessed depending on site conditions.
 - 1. Ademco U.L. Listed

PART 4 - EXECUTION

4.1 INSTALLATION

- A. Install system according to NFPA 70, applicable codes and manufacturer's written instructions.
- B. Comply with UL 1641
- C. Wiring Method: install wiring in raceways, except in accessible indoor ceiling spaces and in hollow gypsum board partitions. Use cable in ceilings. Conceal raceways and wiring.
- D. Wiring within enclosures: bundle, lace and train conductors to terminal points. Provide and use distribution spools and lacing bars.
- E. Number of conductors: As required by system manufacturer for the functions of each device.
- F. Splices and terminations: make connections on numbered terminal strips in terminal cabinets and equipment.
- G. Connections: comply with tightening values specified under UL 486A.
- H. Identify components, conductors and cable according to established criteria under Division 16. Color code conductors and apply wire and cable marking tape to designate wires and cables so writing is identified and in coordination with system wiring diagrams.

4.2 GROUNDING

- A. Ground system components and conductor and cable shields to eliminate shock and hazard and to minimize ground loops, common mode returns, noise pick-up and other impairments.

4.3 FIELD QUALITY CONTROL

- A. Inspection: verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
- B. Manufacturer's field services: have a factory trained service representative to inspect field-assembled components and perform system configuration and programming.
- C. Operational tests: schedule system testing after system has been completely installed. Perform operational system test to verify compliance with manufacturer's requirements.
- D. Retesting: Correct problems and retest until total system meets the requirements of the specifications and compliance standards.

4.4 ADJUSTING

- A. Occupancy adjustment: when requested within twelve months of date of substantial completion, provide on-site assistance and reprogramming to meet actual occupied conditions.

4.5 TRAINING

- A. Provide a factory trained service representative to explain programming and operation of system, train owner's representative on procedures for maintaining the system. Provide a minimum of four (4) hours per system training in operation, programming and maintenance.
- B. Schedule training with owner before commissioning of the system and turnover to the owner.

END OF SECTION 281300

SECTION 281600

INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 GENERAL

- A. It is the intent of these specifications to describe the minimum requirements for the furnishing and installation of an automatic Security and reporting system as described in these specifications. The system shall include, but in no way by limitation to, the following:
1. Combination Security/Central Station Reporting System
 2. Alpha/Numeric Keypads
 3. Perimeter Door Contacts
 4. Motion Detectors
 5. Internal and External Audible Alarms
 6. Conduit, Wire, Outlet Boxes, Complete Installation
 7. System Setup, Programming, and Operator Training
 8. Interface to Card Access Equipment

1.2 OPERATION

- A. The Security System shall be an addressable type where each motion detector, each protected single and overhead door location and other monitored devices shall report as individual points to the system.
- B. Each security device location shall be capable of being programmed into a group of devices or partitions to allow these groups to be armed, disarmed and controlled through specific passwords on any of the keypads.
- C. The system shall allow for programming of individual partitions to be automatically armed and disarmed by:
1. Time of day
 2. Day of week
 3. Holidays
 4. Manually armed or disarmed to override program through the Keypad
- D. Up to 200 individual passwords and operators with 9 Authority Levels for programming and operation of the system.
- E. Generation of reports to the keypad display or optional printer on user data with time and date.
- F. Provide flush mounted door position contacts on all doors to be protected; including all leafs on double or multiple door locations, and connect to the security system. All the doors at one location shall be wired as an individual zone. It shall be possible to monitor these door zones to verify an open or closed position. These devices shall be programmable by location for 24-hour protection. The system shall be expandable up to 512 individual zones.
- G. Motion Detectors shall be installed where shown with built-in addressable zone module or with a point ID module. The units shall operate on the Passive Infrared principle.

INTRUSION DETECTION SYSTEM

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1.3 ACCEPTABLE EQUIPMENT SUPPLIERS

- A. The equipment supplier shall be an Authorized Dealer of Digital Monitoring Products, Inc. and in good standing. Current documentation (within the last 30 days) from the manufacturer shall be provided with the submittals to indicate the "Authorized" status of the Equipment Supplier and that training and experience has been achieved on the products required for the system.
 - 1. Authorized Dealer(s) known to meet these requirements is as follows:
 - a. Berkshire Systems Group, Inc. - 610-775-1200, 1-800-344-4012.

1.4 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: Provide complete shop drawings which include the following;
 - 1. Indicate all system device locations on architectural floor plans. No other system(s) shall be included on these plans.
 - 2. Include full schematic wiring information on these drawings for all devices. Wiring information shall include cable type, conductor routings, quantities and connection details at devices.
 - 3. Include a complete intrusion detection system one-line, block diagram.
- C. Product Data: Provide complete product data that includes the following: Manufacturer=s data for all material and equipment, including terminal devices, local processors, computer equipment and any other equipment provided as part of the system.
 - 1. A system description, including analysis and calculations used in sizing equipment. Description to show how the equipment shall operate as a system to meet the performance requirements of this specification. The following information shall be supplied as a minimum:
 - a. Central processor configuration and memory size
 - b. Description of site equipment and its configuration
 - c. Protocol description
 - d. Rigid disk system size and configuration
 - e. Backup/archive system size and configuration
 - f. Start-up operations
 - g. System expansion capability and method of implementation
 - h. System power requirements and UPS sizing
 - i. A description of the operating system and application hardware

1.5 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Provide manuals including operating instructions, maintenance recommendations, parts lists, riser diagrams, wiring and connection diagrams and termination diagrams modified to reflect as-built conditions.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage and are identified with labels describing contents.
 - 1. Keypad: Furnish 1 of each type and rating installed.
 - 2. Motion Detector: Furnish 5 of each type and rating installed.
 - 3. Door Position Contacts: Furnish at least 2 of each type and rating installed.

1.7 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Digital Monitoring Products, Inc. - (DMP).

2.2 EQUIPMENT

- A. Security/Central Station Control System Software/Hardware - The combination Security/Central Station Control System shall as manufactured by Digital Monitoring Products, Inc. (DMP).
- B. Security Control Unit - Provide access control unit that includes all the required controls, auxiliary power supplies, batteries, and modems to operate the security/access control system. The cabinet shall be a NEMA 1 enclosure with tumbler lock key. The cabinet shall include adequate venting for the power supplies and batteries. Installation that includes multiple cabinets for the required controls at the same location shall not be permitted. CAD drawings shall be supplied of each control location showing the layout of all modules and wiring interconnections. These drawings shall be submitted for approval.
1. The remote controls shall include, but not limited to, the following modules:
 - a. XR-500NL-Network Intrusion Panel
 - b. 714 Series Expansion Modules
 - c. 322 Power Transformer
 - d. Battery Backup - 7 Hour Minimum
 - e. Enclosure with a minimum of 20% spare space capacity
 - f. 860 Relay Output Modules and 305 Plug-in Relays. Provide adequate quantities to interface other systems as necessary for the project.
 2. The panel shall be installed at location shown on the drawings
- C. Zone Expansion Panel - Provide (1) DMP Model 714-16 zone expansion panel.
- D. Door Position Contacts - Provide GE Security Model No. 1078W flush 1" door contacts and magnets in all doors at locations that include a card reader and elsewhere where shown on the drawings.
- E. Motion Detectors - Provide Passive-Infrared motion detectors that are manufactured by Bosch Security. Provide devices as follows (select type as required for locations indicated on the Drawings):
1. Long Range Detectors - Bosch Model DS720i with OA120.
 2. Wide Angle Detectors - Bosch Model MX934i
 3. Ceiling 360° Detectors - Bosch Model DS938Z
 - a. These devices shall be provided with the appropriate mounting accessories that are dependent on the area installed. In addition, each device shall be installed with a Model DMP 711E or 714 Series Zone expander module.
- F. Security Command Keypad - Provide a 32-character alphanumeric LCD keypad with backlit keyboard, four class B input zones, self-test diagnostics, three 2-button panic switches, alert sounder, AC LED and display layout that directs user on operation.

- G. End User Intrusion Management Software - Provide DMP Model # System Link Software and load on HP Workstation Class PC with Keyboard, Mouse and 19" LCD Monitor. This PC will be located in the Office.

PART 3 - INSTALLATION

3.1 INSTALLATION AND WIRING

- A. All equipment in this section shall be installed in accordance with the National Electric Code for security alarm and communications systems. The installation of the equipment manufacturer shall be followed in every manner. The Equipment Supplier shall provide CAD drawings for review and approval. The drawings shall show all field devices and wiring terminations to the remote control units.
- B. Installation shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work.
- C. Install all wiring in accordance with manufacturer's and U.L. recommendations.
- D. Wiring Methods:
 - 1. Wire Routing: Route all device wiring from each device up into ceiling cavity within metallic conduit in recessed or unfinished areas or within surface raceway for renovated non-fishable areas. Stub all conduits into ceiling cavity and provide protective bushing for each.
 - 2. Cable Routing: Route cable for all device wiring within accessible ceiling cavities. Install in J-hooks at 4' spacing maximum to panel. No cabling is to lie on or attach to ceiling tile, ducts, pipes, conduits or ceiling suspension wires, rods or structural members. Provide conduit stubs from devices and panels to the ceiling cavities.
 - 3. Route all intrusion detection wiring from panel within metallic conduit up into nearby ceiling cavity and connect to the wiring system indicated in A and B above. Provide bushings at conduit ends.
- E. Provide cables as recommended by the equipment supplier.
- F. Provide a dedicated 120-volt circuit in separate conduit as a source of primary power for the master control/communicator.
- G. Supply, install, and wire recommended transformers and DC power sources to the master control/communicator. The transformer shall not be shared with anything else.
- H. Perform walk tests and set-up procedures for each detector as specified by the manufacturer to ensure that all boundaries of coverage are sufficient to detect intruders in each secured area.
- I. The alarm contractor shall provide complete wiring diagrams to the electrical contractor as part of the shop drawing submittal, and shall supervise the installation in order to ensure a complete operating and trouble-free system.
- J. Provide 3 sets of keys for all panels, stations, and devices.
- K. Provide dedicated auxiliary power supply units in the Intrusion Detection System Panel as required for operation of auxiliary devices.
- L. Provide interface wiring and equipment to interface system to building local area network, and telephone system.
- M. Provide interface wiring and equipment to interface the access control system.

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3.2 PROGRAMMING AND TEST

- A. After completion of the installation of the system and before the system is turned over to the Owner, the system shall be completely tested by the Equipment Supplier for proper operation.

3.3 TRAINING

- A. The Equipment Supplier shall arrange demonstration and training of the system operation with representatives of the Owner. Multiple visits shall be provided to train the desired personnel that will operate the system.
- B. General: The contractor shall conduct training courses for personnel designated by the Owner. Training shall cover the maintenance and operation of the system. The training shall be oriented to the specific system being installed under this contract including central processor. Training manuals shall be delivered for each trainee with 2 additional copies delivered for archiving at the project site. The manuals shall include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. The contractor shall furnish audiovisual equipment and other training materials and supplies as necessary. Where the contractor presents portions of the course by audiovisual material, copies of the audiovisual material shall be delivered to the Owner on the same media as that used during the training session. Two 4-hour training sessions shall be provided for in the base contract.
- C. Demonstration and Training: The equipment supplier shall arrange for the demonstration and training of the system operation by a professional trainer with representatives of the owner. Multiple visits shall be provided to train the desired personnel that will operate the system. The training shall up to a 24 hour maximum and shall be based on the Owner=s needs during the first year of operation.

3.4 TESTING

- A. General: The contractor shall perform pre-delivery testing, site testing, and adjustment of the completed system. The contractor shall provide all personnel, equipment, instrumentation and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Owner at least 14 days prior to the test, and in no case shall notice be given until after the contractor has received written approval of the specific test procedures. Test procedures shall explain in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. Test reports shall be used to document results of the tests. Reports shall be delivered to the Owner within 7 days after completion of each test.
- B. Performance Verification Test: The contractor shall demonstrate that the completed system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown.
- C. Programming: After completion of the installation of the systems and before the system is turned over to the Owner, the system shall be completely tested by the equipment supplier for proper operation. Programming shall include the initial setup of the software in preparation of the Owner programming the system.

END OF SECTION 281600

SECTION 282300

VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Closed circuit television surveillance system.
- B. Accessories.

1.2 REGULATORY REQUIREMENTS

- A. System: UL Listed.
- B. Conform to National Electrical Code.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Company headquartered in the United States and doing business for no less than five years - specializing in CCTV systems.

1.4 SUBMITTALS

- A. Submittal must be provided for all equipment so that it shall be determined that all equipment meets specification standards.
- B. Shop Drawings: Indicate layout, wiring diagrams, and dimensions.
- C. Product Data: Submit data sheets for each item of equipment, equipment ratings, and for finishes.
- D. Manufacturer's Installation Instructions: Indicate installation instructions.
- E. Manufacturer's Certificate: Certify that system meets, or exceeds, specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Accurately indicate actual location of equipment.
- B. Operation and Maintenance Data: Include operating instructions and maintenance and repair procedures.

1.6 WARRANTY

- A. Provide one year equipment warranty.

1.7 SYSTEM DESCRIPTION

- A. Provide a complete and operational closed circuit television surveillance system with the performance criteria detailed in this specification. System shall be inclusive of necessary functionality, cabling, equipment, etc. as detailed herein and on the contract documents.
- B. Contact Sage Technology Solutions, Inc. - Mr. Charlie Mowrer -(717) 653-6641
- C. System shall provide long term digital storage of recorded video.
- D. Remote live monitoring and surveillance of multiple location simultaneously.
- E. Multiple user simultaneous access to the same site for live and/or recorded video.
- F. Recording Options:
 - 1. Record Motion, always or on Schedule for each camera
 - 2. Each camera shall able to be set to record at different resolutions, fps, and quality
 - 3. Each camera shall be set to record a Pre and Post Motion buffer
 - 4. System shall allow Customizable motion recording sensitivity; the user shall create multiple motion sensitive zones that have unique specifications.
 - 5. Each camera shall be able to be configured for the maximum amount of disk space used for recording.
 - 6. The maximum file size shall be specified
 - 7. Create a clip by use of start and end points and then write directly to CD
- G. Rapid search by time/date for the following events: Camera, session, system, maintenance, input, output, video-loss, recorded data and motion detection.
- H. User selectable automatic reporting of events to multiple sites.
- I. Digital PTZ dome and general purpose output control capability.
- J. Communication options with system shall include LAN/WAN.
- K. System shall be provided for user definable encrypted password protection.
- L. System shall be operated via a user friendly GUI - Windows™ interface. System shall be capable of being accessed via Microsoft Internet Explorer or Netscape browsers.
- M. Fixed position cameras with variable focus lenses shall be provided as indicated. All camera locations shall be cabled and prepared for future pan/tilt/zoom type camera. Cameras shall be in vandal and tamper resistant housings.

1.8 SYSTEM CONFIGURATION

- A. Indoor and outdoor cameras and housing shall be provided and wired as indicated.

- B. System shall be equipped for the number of cameras as indicated including control, video storage and power supply equipment. Cameras shall be provided as indicated.

PART 2 - PRODUCTS

2.1 Video Management System Software overview

- A. Basic Architecture: The exacqVision Video Management System (VMS) software shall be used to view live and recorded video from IP cameras and video encoders connected to local and wide area networks. The VMS software shall have a Client/Server-based architecture that can be configured as a standalone VMS system with the Client software running on the server hardware and/or the Client running on any network-connected TCP/IP PC workstation. Multiple client workstations shall be capable of simultaneously viewing live and/or recorded video from one or more servers. Multiple servers shall also be able to simultaneously provide live and/or recorded video to one or more workstations. Included in the cost of the software shall be an unlimited number of client software applications.
- B. IP Camera and Encoder Support: The VMS software shall have an open architecture supporting IP cameras and encoders from multiple manufacturers providing best-of-breed solutions ranging from low-cost, entry-level features to high-resolution, megapixel features. A minimum of eight (8) IP camera manufacturers shall be supported from leading companies such as ACTi, Arecont Vision, AXIS, Basler, IQinVision, ioimage, Panasonic, Sanyo, Sony, StarDot, and Vivotek.
- C. VMS Client Server Architecture: The VMS software shall be based on a Client/Server architecture that provides a scalable platform, whereby each computer on a network is a client, a server, or both a client and a server simultaneously.
- D. VMS Client Software: A client is a computer system that accesses a remote service on another computer through a TCP/IP network. The VMS Client software displays and searches live and recorded video, audio, and alarms; and administers the VMS Server configurations.
 - 1. One VMS Client application shall be installed in two different configurations depending on requirements. The VMS Client shall have the same features, functions, and user interface in either configuration. The first client installation configuration shall be referred to as a Local Client, meaning the client resides on the same system that is local to the server. The second installation shall be referred to as a Remote Client, meaning it is installed on a different computer that is "remote" from the server and is connected to the server through a local or wide area network. All interaction (viewing live or recorded video and administration) with the server shall be performed through either the Local or Remote client.
 - 2. When configuring a server with full administrative privileges with either a Local or Remote Client, all administration and configurations functions shall be identical. By having full administration and configuration features from a Remote Client, customers and installers shall not be required to administer features where the server hardware is physically located.
 - 3. Video recording shall be allowed to continue at all times during the administration and configuration of any feature of a server from either a Local or Remote. The VMS Client software shall have the same

- functionality when connected remotely as it does when it is run locally on the same computer as the server software.
4. The VMS Client software shall operate on any of the following operating systems:
 - a. Microsoft Windows Server 2003/2008
 - b. Microsoft Windows 7 (all versions)
 - c. Linux Ubuntu 6.06/8.04/10.04 Debian Package
 - d. Mac OSX (operating on Intel CPU)
 5. Any combination of VMS Client applications running on any of the supported operating systems shall be able to connect to view and retrieve live or recorded video from any of the VMS applications running on any of the operating systems. For example, a VMS Client running on Microsoft Windows Vista shall be able to simultaneously connect to four (4) different VMS Servers all running on different operating systems, such as Windows Server 2003, Windows XP, Vista, and Linux.
- E. Thin Client Browser: Client Browser shall allow connections to multiple VMS Servers simultaneously to display live video, recorded video, and PTZ commands. The Client Browser shall operate without installing any software. The VMS Server shall transcode the video into a JPEG file of the size as the browser screen before sending it to the browser. The Client Browser shall display live or recorded video on a PC, Mac, Linux PC, PDA, iPhone, or CEL phone using the following browsers:
1. Internet Explorer 6, 7, or 8
 2. Firefox 2 or 3
 3. Opera 9 and later
 4. Safari 2 or 3
 5. The Client Browser shall also connect with non-JavaScript browsers and shall be compliant with HTML 4.0 (www.w3.org).
- F. VMS Client on Multiple Monitors: The VMS software shall have the capability to run multiple client applications simultaneously on one workstation with multiple monitors. Up to twelve (12) monitors shall be configured on a single workstation with one (1) client application running on each monitor. Because decompressing video is CPU-intensive, the PC workstation shall have multiple core processors, with a recommendation of one core for each VMS client application.
- G. VMS Server Software: A server is a computer system that provides services to other computing systems (clients) over a TCP/IP network. The VMS Server software shall record and retrieve video, audio, and alarm data and provide it to the VMS Clients upon request. The VMS Server software shall operate on any of the following operating systems:
1. Microsoft Windows Server 2003/2008
 2. Microsoft Windows 7 (all versions)
 3. Linux Ubuntu 6.06/8.04/10.04 Debian Package
- H. Standalone Client/Server: A client and server can simultaneously reside and operate on one computer and communicate to each other through a TCP/IP loopback interface, a special IP address (127.0.0.1) that is designed for the client and server software to communicate with each other on the same computer. By combining the functionality of the VMS Client and Server software on one system, administrators shall be able to deploy both standalone and network configurations that can scale as required. The administrator shall have the added benefit of configuring and administering the VMS server with identical features either locally or remotely.

- I. Edge-based Motion Detection: When using motion-based video recording, the VMS server software shall be based on metadata generated by the edge network device. The edge network devices shall generate the metadata and transmit it with the video stream to the VMS server software. The motion detection feature of the edge device shall generate an alarm whenever movement occurs in the image. The VMS server software shall read the metadata from the edge device to determine if motion occurred, and then it shall records video if it did occur. The benefits of using edge device motion detection vs. server (host processor) based motion detection shall include:
 - 1. Reduced server processor speed requirements
 - 2. Reduced server memory requirements
 - 3. Reduced processor heat
 - 4. Reduced CPU processor usage
 - 5. Increased IP camera connectivity
 - 6. Increased IP camera throughput
- J. Licensing VMS Software: The VMS server software shall have a feature to license the MAC address of the server hardware, either the integrated Ethernet controller or add-in Ethernet adapter. Licensing individual IP cameras or encoders shall not be required. Licensing the server shall simplify the installation and management of IP cameras or encoders by eliminating the need to provide additional MAC addresses for all the individual devices (IP cameras or encoders). If an IP camera or encoder fails to operate for any reason, an administrator shall be able to add a new IP camera or encoder to the VMS server software without obtaining a new license key.
- K. Running as a Service: The VMS server software shall run as a service. If the VMS Client software is shut down, the VMS server software service shall continue to record video and perform all other configured functions.
- L. Installing and Updating VMS Client Software: Installing a new release of the VMS Client software shall be accomplished by clicking on an icon in the Client software that connects to the Internet and provides an option to automatically download and install the updated software. If the user has already installed the most recent version of the VMS software, a message box shall be displayed with that information.
- M. Installing and Updating VMS Software: New releases of the VMS software shall be easily accessed from a website. The server software and client software shall be bundled in a single executable file. When running this executable, the VMS software shall give the user the option to install each individual component of the VMS software. The VMS Software shall also have an option for a silent install that allows the pushing of software upgrades for large deployments.
- N. VMS Software Advanced Enterprise Features: The VMS software shall not require an additional installation when using the Enterprise features; only a license change shall be required. The VMS software shall have the following Enterprise features:
 - 1. Active Directory/LDAP integration - The VMS shall be able to use the Active Directory or LDAP features of an enterprise-class network to authenticate users and determine which permissions they will have on each servers.
 - 2. Enterprise User Setup - The VMS shall allow for a user's permissions to be configured across multiple servers from a single screen.
 - 3. Multi-Level Mapping - The VMS shall allow maps to be embedded inside of maps. When an event happens on a map that is embedded inside of a map,

it shall transmit the alert to all parent maps and change the color of icon on the parent map and all subsequent parent maps.

4. Overall Systems page - The VMS shall have a single page that displays the status of all servers currently connected. This page shall display any alarms or events that are currently occurring, MAC addresses, and license information from each individual server.

- O. Third-Party Software Integration: The VMS software shall have three (3) methods of allowing third-party integration: Command Line, API, and Web SDK. The command line shall allow for the most basic of interfaces, calling up the appropriate video when requested using command line functionality. The API shall allow for a deeper interface, allowing video to be transmitted from the VMS software into the party software interface. The Web SDK shall use the web server to transcode the video and send it to the third-party software interface. The Web SDK method shall use standard HTML, XML, CGI, and JavaScript commands.

2.2 VIDEO MANAGEMENT SYSTEM SOFTWARE FEATURES

- A. Operating Modes: The VMS software shall have three main modes of operation depicted by three icons. Clicking on any of these icons below shall change the mode of operation:
 1. Live Display Mode Icon allows users the ability view live video.
 2. Search Mode Icon allows users the ability to search for recorded video.
 3. Setup Mode Icon allows Administrators and Power Users the ability configure systems.
- B. Live Display Mode Features: A live display mode shall be used to view live video, Point of Sale data, and alarm information. The live display mode shall have the following features to navigate and view live video:
 1. Layout Icons - The VMS shall be used to organize the camera video view panel in the following patterns:
 - a. 1-camera (full-screen) layout
 - b. 4-camera (2x2) layout
 - c. 9-camera (3x3) layout
 - d. 12-camera (4x3) layout
 - e. 16-camera (4x4) layout
 - f. 20-camera (5x4) layout
 - g. 30-camera (6x5) layout
 - h. 48-camera (8x6) layout
 2. Navigation Tree - The VMS shall display cameras, alarms, monitor, Point of Sale, and audio icons that are connected to the VMS server.
 3. Navigation Pane - The VMS shall display a hierarchy of cameras, audio input, and serial port input icons organized by Cameras (cameras connected to servers), Groups (logical grouping of cameras), Maps (cameras placed on maps), and Views (saved live display layouts). Clicking on navigation pane bars shall switch the navigation tree into the desired navigation tree display.
 4. Video View Panel - The VMS shall display video from cameras. Cameras shall be dragged from the navigation tree into the view panel to display their live video. If multiple video view panels are in a layout, video shall be moveable by dragging video from one view panel to another panel.
 5. About Icon - The VMS shall provide information about the version number of the client software in use. The VMS shall provide an option to update to the latest version of the client by clicking on a link in this section.

6. Help Icon - The VMS shall provide context-sensitive documentation from the online user manual.
 7. Show/Hide Navigation Tree Icon - The VMS shall have the ability to hide the Navigation Tree.
 8. Full Screen Icon - The VMS shall enlarge the video display area by hiding the title and task bars.
 9. PTZ Control Icon - The VMS shall provide PTZ control that allows the maneuvering of a PTZ camera. The VMS shall also allow the calling of PTZ presets by either right-clicking on the camera cell and then selecting the PTZ Preset, or by clicking the PTZ Control Icon and then pressing the PTZ Preset number.
 10. Date and Time - The VMS shall display the current date and time.
 11. Soft Trigger Icon - The VMS shall allow the customization of the user interface to allow software triggers to be shown. The VMS shall allow the user to pick their own icon and select the software triggers to display in the client. The VMS shall also display the status of any soft triggers on connected VMS servers.
 12. Event Buttons - The VMS shall allow the user to monitor live video from a remote location using a separate client application. The VMS shall allow the user to send a notification (Soft Trigger) via the server housed at the location being monitored. The VMS Software client shall allow the activation of Soft Triggers from the Live Video page by clicking a pre-configured icon.
- C. Pan, Tilt, and Zoom (PTZ) Controls; The VMS software shall control PTZ cameras and be used to maneuver a mechanical PTZ camera and digitally pan, tilt, and zoom on any video. The following methods of controlling a PTZ camera shall be available:
1. PTZ graphics control windows
 2. Live graphic overlay PTZ control icons
 3. Keyboard control (Up, Down, Left, Right Arrows; Page Up, Page Down for Zoom)
 4. PTZ presets
 5. Digital PTZ
 6. USB joystick to control PTZ cameras
 7. Proportional PTZ control by clicking the mouse in the center and moving it
- D. Auto Replay of Recorded Video from Live Display Mode: The VMS software shall replay recorded video from the Live Display Mode if the user right-clicks in the appropriate video view panel and selecting Replay. The user shall have the option of reviewing video in increments of 5 or 30 seconds; or 1, 5, or 15 minutes. The Replay window shall open and begin downloading the recorded video. A Scrub Bar shall track the progress of the download. The total number of frames in the video segment and the number of frames that have been downloaded shall be displayed in the status bar. The download shall end if the user clicks a Stop Download button.
- E. Virtual Matrix Switching; The VMS software shall activate virtual matrix switching if the user right-clicks in one of the live video panels and selects Event Monitor from a drop-down dialog menu and then selects a profile. Virtual Matrix Switching shall automatically show video as it is triggered. Virtual Matrix Switching shall be stopped if the user right-clicks in the active video panel and disables the active event monitoring profile.
- F. Event Monitoring: The VMS software shall activate event monitoring if the user right-clicks in one of the live video panels and selects Event Monitor from a drop-down dialog menu and then selects a profile. An Event Monitoring

profile shall display a list of events that the user can click on to view. If a profile is configured for Event Monitoring mode, an Event Monitoring Box shall appear below a live video panel. The box shall be moveable and resizable. When a video event takes place, it shall be automatically listed in the box that can be clicked on to display the video. When events occur on two cameras at the same time, each event can be viewed for as long as necessary. Event Monitoring shall be stopped if the user right-clicks in the active video panel and disables the active event monitoring profile.

- G. Viewing Logical Camera Groups: The VMS software shall have a feature for viewing logical groups of cameras. The VMS software shall also have a feature creating camera groups. This shall allow efficient viewing of cameras in a logical order. Once camera groups are configured, cameras shall be selectable in those groups if the user clicks on the Group button in the Navigation Pane.
- H. Creating, Saving and Accessing Views: The VMS software shall have a feature to organize your cameras into preset Views by selecting a Layout button in the Live mode and dragging the cameras to the appropriate spot on the Video View Panel. After saving a view, it shall be accessed by clicking the View button from the Navigation Pane. Selecting a view from the Live Views Site Tree shall display the camera layout in the Video View Panel. The VMS software shall have the capability to create and organize views into folders.
- I. Video Tours: The VMS software shall have the capability to automatically cycle through two or more saved views to create a Video Tour by selecting the desired views typing a description of the tour. A dwell time shall determine the amount of time, in seconds, that each view remains in the Video View Panel before the next view is displayed. The tour shall be activated by clicking on the saved tour description icon visible in the View Navigation pane.
- J. Search Mode Overview: The VMS software shall be used to search for and play back recorded video, audio, and events from VMS servers. The system shall also be capable of performing searches on multiple cameras based on specific criteria. The VMS search software shall have the following features:
 - 1. Input Selection Tree - a list of camera(s), audio input(s), or text data to search.
 - 2. Navigation Pane - a list of cameras, video, audio, and events organized by cameras, groups, maps, and views.
 - 3. Video Time Line - a time line of video displayed in increments of 5 minutes, or 1, 8, or 24 hours.
 - 4. Zoom In (+) and Zoom Out (-) Buttons - zooms in and out on the video time line.
 - 5. Camera Selection List - a list of cameras that have been selected from the camera selection tree.
 - 6. Video Cursor - selects the segment of video to play back. Single-clicking shall move the video cursor to a new location; double-clicking shall start video playback.
 - 7. Recorded Bar - bars that represent recorded video or audio.
 - 8. Video Playback Controls - includes the following controls:
 - a. Play video in reverse in fast (double) speed
 - b. Play video in reverse in normal speed
 - c. Stop video play
 - d. Play video forward in normal speed
 - e. Play video forward in fast speed
 - f. Play video forward one frame at a time
 - g. Play video backward one frame at a time

9. Calendar - used to select the day of the video search
 10. Start Search Time - used to change the time of the video search
 11. Search Button -initiates a new video search based on changes that have been made in the camera selection tree, calendar, and start time.
 12. Video Playback Window - video window that video is played back in.
 13. Export Buttons - includes Save Picture, Save Video, Print Picture, and Burn to CD or DVD.
 14. Scrub Bar and Scrub Handle - used to quickly scrub back and forth through video.
 15. Stop Download Button - used to stop the download.
 16. Smart Search - allows search for occurrences of motion in specific areas of a video window.
- K. Multi Camera Search and Playback: The VMS software shall have the capability to search for and play back video from multiple cameras simultaneously. All recorded video shall be played back and displayed in a synchronized multi camera layout in one of the following screen layouts:
1. 4-camera (2x2) layout
 2. 9-camera (3x3) layout
 3. 12-camera (4x3) layout
 4. 16-camera (4x4) layout
 5. 20-camera (5x4) layout
 6. 30-camera (6x5) layout
 7. 48-camera (8x6) layout
 8. Selected pre-configured views
- L. Audio Search and Playback: The VMS software shall allow search and play back of audio in synchronization with video.
- M. Exporting Files: The VMS software shall have the capability to export video, maps, Point of Sale data, and audio files. To export a file, the user shall mark the starting and ending point of the video to export. After the VMS software has exported a video and/or audio file, it shall provide an option to burn the data to a CD or DVD. The VMS software shall provide the option of exporting the file in the following formats:
1. Standalone Exe (*.exe) - includes an executable player with the video and audio data
 2. AVI File (*.avi) - a multimedia container format
 3. PS File (*.ps) - a format for multiplexing video and audio
 4. QuickTime File (*.mov) - native for Macintosh computers
- N. Copy, Save and Print Images: The VMS software shall also be used to save and print an image. The VMS software shall have the capability to copy a picture to a clipboard and paste it into a document.
- O. Standalone Player: The VMS software shall have the capability to export video and audio files with an executable Standalone Player. Double-clicking on the executable Standalone Player shall start the application and open the video and/or audio files. The Standalone Player shall have the following features:
1. Screen Layouts:
 - a. 1-camera layout - full-screen layout
 - b. 4-camera (2x2) layout - simultaneous multi-camera playback
 - c. 9-camera (3x3) layout - simultaneous multi-camera playback
 - d. 16-camera (4x4) layout - simultaneous multi-camera playback
 2. Video Playback Controls - includes the following playback controls:
 - a. Play video in reverse fast (double) speed
 - b. Play video in reverse in normal speed
 - c. Stop video play

- d. Play video forward in normal speed
 - e. Play video forward in fast speed
 - f. Play video forward one frame at a time
 - g. Play video backward one frame at a time
 3. Scrub Bar and Scrub Handle - used to quickly scrub back and forth through video.
 4. Camera and Audio Tree - used to select video and audio for playback
 5. File:
 - a. Open
 - b. Save Image
 - c. Copy to Clipboard
 - d. Save as AVI, PS, or QuickTime
 - e. Print
 - f. Exit
 6. Options:
 - a. Show Camera Name
 - b. Show Timestamp
 - c. Show Status Boarder
 - d. Time-lapse Playback Interval
 - e. Show Camera Tree
 - f. Show Full Screen
 - g. Font
 7. Tools:
 - a. Authenticate- used to verify the video hasn't been tampered with or corrupted.
 - b. A keyed-Hash Message Authentication Code, or HMAC, is a type of message authentication code (MAC) calculated using a specific algorithm involving a cryptographic hash function in combination with a secret key. As with any MAC, it can be used to simultaneously verify both the data integrity and the authenticity of the data.
 8. Right Click on Video:
 - a. Clear this video panel
 - b. Digital PTZ
- P. Setup Mode Overview and Features: The VMS software shall be used by Administrators and Power Users to configure systems. A Setup Mode shall consist of a hierarchy of icons for configuring the systems, also called a configuration tree. Clicking on any of the icons in the configuration tree shall display a new screen for configuring the selected item. The configuration tree shall consist of the following icons and features:
1. My Systems
 2. Adding System
 3. Client Setup
 4. Joystick Setup
 5. Enterprise User Setup
 6. Event Monitoring
 7. Group Setup
 8. Map Setup
 9. System Information
 10. System Setup
 11. Add IP Cameras
 12. IP Camera Recording Setup
 13. IP Camera Setup
 14. Audio Input Setup
 15. Trigger Input Setup
 16. Alarm Output Setup
 17. Storage Setup
 18. Serial Profile Setup

19. Serial Port Setup
20. Notifications
21. Instant Recall Setup
22. Event Linking Setup
23. Schedule Setup
24. User Setup

- Q. My Systems: The VMS software shall have a feature for displaying systems that have been added to the Client software, including the system name, system status (connected or not connected), and the IP address of the systems, licensing status, and software subscription status. If there is one standalone system (VMS Client and Server software running on the same server hardware), one system shall be displayed. If multiple systems are configured, the status of multiple systems shall be displayed. When connected to systems that are licensed as Enterprise systems, the subscription status, version, and alarm status shall also be displayed. Right-clicking the license information shall also display both the MAC address and license of each server.
- R. Adding Systems: The VMS software shall be used to configure the Client application to connect to VMS servers. Entering a VMS username, password, and IP address shall connect the Client application to the VMS for viewing live and recorded video. Multiple VMS shall be allowed to be added to the system list. Client applications shall be able to connect to multiple servers simultaneously. After a system has been added to the Systems List, the Client shall automatically connect to the system. All authorized video viewing, searching, and system configuration functions shall be available to the Client application.
- S. Client Setup: The VMS software shall be used to configure the Client software based on personal preferences, including the following:
1. Live video border display status (on or off) and PTZ focus
 2. VGA acceleration options
 3. Time-lapse playback speed
 4. Configuration icon for restricted users (show or don't show)
 5. Event button customization
 6. Color customization display options for:
 - a. Motion recording
 - b. Alarm recording
 - c. Free run recording
 - d. PTZ focus
 - e. Event Monitoring
- T. Joystick Setup: The VMS software shall be used to configure any standard USB joystick to work with the VMS Client workstation. There shall be Position Controls that can be adjusted to personal preferences. The sensitivity of the joystick shall be adjusted by moving the Sensitivity slide bar to the left, making it less sensitive; or to the right, making it more sensitive. Features shall also alter the north and south movement of the camera or view. When the Invert Y Axis checkbox is selected, the PTZ camera view shall move north when the joystick is moved down and South when it is moved up. This shall be reversed by deselecting an Invert Y Axis checkbox. The camera or camera view shall zoom in or out by twisting the joystick to the right or left, depending on personal preference. When the Invert Rudder checkbox is selected, the camera shall zoom in by twisting the joystick the left and zoom out when it is twisted to the right. Deselecting the Invert Rudder checkbox shall reverse the zoom control. One or more of joystick buttons shall be programmed by using a drop-down menu to select the following settings:

1. PTZ Zoom In/Out
 2. Increase/Decrease PTZ Zoom Speed
 3. Increase/Decrease PTZ Pan/Tilt Speed
 4. Next/Previous Video Panel
 5. View This Camera Only
 6. Toggle Digital PTZ
 7. Traverse the Camera Tree
 8. Go to PTZ Preset Number 1-16
 9. Open the Find Camera dialog
- U. Enterprise User Setup: The VMS software shall allow the configuration of the same user accounts across several servers from the same interface. The Enterprise User Setup shall allow an administrator to create a user account, assign a password, and assign a Group, and then choose the servers on which the user should have permissions.
- V. Event Monitoring Setup: The VMS software shall be used to configure the VMS Client to react to events that take place on servers to which it is connected. To activate the event monitoring feature, the user shall create and define a new event monitoring profile — a set of actions such as the playing of live video or an alarm sound — triggered by sources such as video motion and input triggers. Each profile shall then be activated and assigned to a specific video panel by the user. The following event monitoring profiles shall be available:
1. Virtual Matrix: A Virtual Matrix profile shall automatically show video as it is triggered. For example, if there is a series of entrances in one profile, each time any of the entrances is triggered the video panel could switch to the camera displaying the most recent door motion.
 2. Event Monitor: An Event Monitor profile shall display a list of events that the user can click on to view. For example, instead of the video panel automatically switching to the camera displaying the most recent door opening, the event could be added to a list. The user could then click on the item to display the video, even if events occur on two cameras at the same time. Instead of seeing each event for a split second, the user shall see each event for as long as needed. After the Event Monitoring Profiles have been created, the user shall activate them in the VMS Client software.
- W. Group Setup: The VMS software shall be used to create logical groups of cameras from cameras connected to a single or multiple VMS servers. The logical groups of cameras shall be displayed in the navigation tree hierarchy of cameras. For example, with two VMS servers with 50 IP cameras each in a four story building and 25 cameras on each floor, the user could create four named groups consisting of 25 cameras each. In addition to monitoring live video, groups shall be used for searching video. In the search video feature, the user shall click on the Groups navigation pane then select the group and search.
- X. Map Setup: The VMS Software shall allow the user to place video cameras on a map to show where they are located and which direction they are facing. The map shall be created using any readable graphics format. The VMS software shall be able to display live and recorded video from this map and detect any events or status changes occurring on those cameras. When using an Enterprise class license, the VMS software shall be able to embed maps with in maps. When an event happens on a map that is embedded inside of a map, it shall display the alert on all parent maps and change the color of icons on the parent map and all subsequent parent maps.

- Y. System Information: The VMS software shall be used to display system information about users that are currently logged into the system, plug-in file version information number and status, and a system log that contains a detailed history of the process that occur on the system. The system log shall be viewed by selecting the start and end date and time and clicking on the search button. The system log shall also be exportable to a file name and opened with a text editor. A log settings feature shall give the user the ability to set the maximum days that logged alarms and the system logs are kept on the system.
- Z. System Setup: The VMS software shall have the following features to set up VMS servers:
1. System name
 2. Time and date
 3. Time zone
 4. Time server
 5. Network settings (hostname, IP address, network, gateway and DHCP status)
 6. Bandwidth settings
 7. License key - required to add the number of IP cameras needed for the system. A user shall obtain a license key by providing your network adapter hardware MAC address to the VMS software manufacturer. The VMS software manufacturer shall provide a license key that must be entered manually in the license key edit fields or imported from a file.
 8. Importing and Exporting System Settings - every feature in the system that is configured through the Setup Mode site tree shall have the ability to be imported or exported to or from other systems.
 9. Active Directory/LDAP - the VMS software shall be configured to connect to a LDAP or Active Directory server. This shall allow the VMS software to authenticate users and groups in an enterprise environment and assign permissions to them.
- AA. Add IP Cameras: The VMS software shall be used to add IP cameras to the VMS server. After IP cameras have been added to a list of IP cameras on the VMS server, the VMS Client software shall be used to configure the IP camera settings and view live and recorded video.
- BB. IP Camera Recording Setup: After IP cameras have been added to the VMS server, the VMS software shall be used to enable IP cameras to record video, select the recording resolution, and select the image-per-second (IPS) recording rate. Each IP camera shall be individually configurable. If a camera has been connected to a VMS server and the camera is producing a video signal, the VMS Client software shall automatically detect the video signal and record video. To disable recording, the user shall select a checkbox. The VMS software shall be used to change individual camera resolutions by clicking on a record resolution drop-down menu and selecting QCIF, CIF, 2CIF, D1, VGA, 1M, 1.2M, 1.3M, 1.9M, 2M, 3.1M, 5M, or 10M resolution. Camera resolutions shall vary depending on the IP cameras selected and added to the VMS server.
- CC. IP Camera Setup: The VMS software shall be used to configure individual IP camera settings such as camera name, onscreen display, PTZ preset settings and tours, digital PTZ presets, video settings (brightness, contrast, saturation and sharpness), recording quality, compression format (MPEG-4, H.264 or JPEG), pre-motion recording, crop window, motion masks (sensitivity, percentage, include, and exclude), and video masks. Some of the settings shall vary depending on the type, model, and features of IP camera selected and added to the VMS server.

- DD. Audio Input Setup: The VMS software shall be used to configure audio input names and enable audio inputs for recording. The VMS software shall be installed with the audio inputs disabled due to legal restraints on audio recording in some jurisdictions. To assign a new, logical name for the audio input channel, the user shall highlight the default name and type the new name. The user shall enable the audio input channel by selecting a checkbox. A listen feature shall allow verification of the audio input connected to a channel. The user shall select a checkbox to hear the audio from the corresponding input channel. To stop the live audio feed, the user shall deselect the checkbox.
- EE. Trigger Input Setup: The VMS software shall be used to configure input trigger names and the Normal State (NO = Normally Open and NC = Normally Closed) of the triggers. The user shall assign new logical names and optionally change the Normal State from the default of NO to NC. The user shall verify the proper operation of the input state on the Trigger Input setup screen by observing the Status state, which shall switch between Normal and Alarm. By default, the Normal State shall be set to NC (Normally Closed). The Status state shall switch from a green NORMAL to a red ALARM indicating that an alarm has been detected. The alarm shall be linked to an action such as recording video or triggering a relay by use of the Event Linking feature.
- FF. Alarm Output Setup: The VMS software shall be used to configure alarm output names and set the Normal State of the IP camera's output triggers. The user shall assign new logical names and change the Normal State of the Alarm Outputs from the default of Hi (5 VDC) to Lo (0 VDC). The Status shall be NORMAL in either the Hi or Lo Normal State setting until an event from the Event Linking feature activates an ALARM status. The user shall verify the proper operation of the output state by observing the Status state, which switches between Normal and Alarm. By default, the Normal State shall be set to Hi (5 VDC).
- GG. Storage Setup: The VMS software shall be used to configure hard drives for video storage. The VMS software shall be installed on your C: drive, and separate disk drives shall be used for video storage. The video storage disk drives shall be designed for high-duty-cycle. Disk drives shall be visible during configuration for review and adjustment. The VMS software shall enable or disable a drive for video storage by selecting or deselecting the enabled feature during storage setup. The entire disk drive shall be used or an upper limit shall be selected by adjusting a video space slider. The VMS software shall have a feature to display the used space that displays the amount of the disk drive capacity used for storage. The VMS software shall display the status of a healthy or missing disk drive. Another feature shall indicate the age of the oldest video recorded on this system. The VMS software shall capture images periodically (time lapse recording) even if the cameras are set to record only upon motion or alarm. The user shall select the desired time lapse increment in hours, minutes, or seconds. Selecting zero shall disable this feature. The VMS shall also have the ability to enforce storage rules on a per-camera basis and allow the user either to limit the number of days of recording or to retain the video for a specific number of days. When the setting is configured to limit the number of days of recorded video, the VMS software shall delete any video older than the selected number of days. When the VMS software is configured to keep the video for a specific number of days, it shall maintain the recorded video to the exclusion of recording all other video.
- HH. Serial Profile Setup: The VMS software shall be used to create and view transaction profiles so that character strings such as cash register

receipts, ATM transactions, or access control transactions can be viewed with live or recorded video. Event keywords shall trigger a system alarm or action. Recorded video shall be searched and retrieved using a search serial feature. The user shall also be able to indicate the beginning and end of transaction key words.

- II. Serial Port Setup: The VMS software shall provide two ways to receive serial data and control PTZ cameras. The VMS software shall allow the user to create a physical connection to the serial port or communications port on the back panel of the server. The VMS software shall also allow the user to transmit serial data over a network connection in ASCII format. The VMS software shall be used to configure serial ports on the VMS server so that they can be used to communicate with serial devices such as Point of Sale terminals or PTZ cameras. The VMS software shall provide a choice for configuring the serial port, including Unused, POS (Point Of Sale), or PTZ (Pan Tilt Zoom). The PTZ option is used to control the motion of a PTZ camera. The VMS software shall default to Unused until it is otherwise configured. A unique name shall be assigned to the port. The VMS software shall also allow the user to receive data over the network using three different methods: HTTP, TCP, and sending data to a specific port on the server.
- JJ. Notifications: The VMS software shall be used to configure an e-mail server and message profile that will send an email message when an event occurs. The user shall use the Event Linking feature to configure the events that should cause an email message to be sent. The E-mail Server Configuration feature shall allow the user to configure the outgoing SMTP mail server that should be used to send email from the VMS server. The VMS software shall also support SSL and TLS connections for transmissions of the mail.
- KK. Instant Recall Setup: The VMS software shall have a feature to export a video segment from specific cameras or audio inputs to a CD or DVD upon an input trigger or other event being activated. The software shall also send an email or text message notifying the recipient that the input trigger has been activated. The VMS software shall be used to create a profile that determines the number of minutes of recorded video that occurs before and after the instant recall is activated that is recorded. The Event Linking feature shall be used to link the profile to the type of event that should cause the video and audio segment to be exported.
- LL. Event Linking: The VMS software shall be used to connect different types of events, such as input triggers, to a desired action such as recording video or triggering an alarm. An event shall activate an action and be stored in a searchable database. The VMS software shall recognize the following event types:
1. Video Motion
 2. Video Loss
 3. Input Trigger
 4. POS Port
 5. POS Profile
 6. Health
 7. IP Camera Connection
 8. Manual Event-Soft Trigger
 9. Analytics
- MM. The VMS software shall recognize the following action types:
1. None
 2. Record Video
 3. Output Trigger

4. Output Video 1
 5. Notify - email and text notification
 6. Instant Recall
 7. PTZ Preset
- NN. Pre and Post Triggers shall be used to trigger certain action types before and after an event occurs. For example, if a door opening is set to trigger video recording, a Pre and/or Post Trigger shall be configured to capture the video for up to 100 seconds before and/or after the door opened.
- OO. Event Buttons: The VMS software shall be used to assign manual events or soft triggers to event buttons. When an event button is assigned, the VMS software shall activate trigger by manually clicking on an event button.
- PP. Schedule: To maximize the amount of storage on your VMS server, the user shall be able to schedule camera, audio, and event recording based on individual needs. For example, the user shall be able to configure recording video during business hours, but record only motion or event video after business hours. The VMS software shall be used to configure camera and event recording schedules. By default, the VMS software record motion as the default schedule. The default Event schedule shall be event recording, as configured in the Event Linking feature. The system shall have the following modes of video recording:
1. Motion (Blue) means video is recorded when motion is detected.
 2. Free Run (Green) means video is continually recorded nonstop.
 3. Alarm (Red) means video is recorded when there is a triggering event.
 4. Off (White) means video is no video recorded.
- QQ. The system shall have the following scheduling features:
1. Day - customize the recording schedule by day
 2. Camera - customize the recording by camera
 3. Event - enables or disables events for a particular time and day
 4. Audio - customize the audio recording schedule
- RR. Users Setup: The VMS software shall be used to add or delete users of the VMS server. The User Setup screen shall allow the user to configure a user group access level and the cameras they have access to viewing. A user shall have the ability to login to view live and recorded video. Adding a new user to the VMS server shall consist of creating a username, password, and group access level (also known as privileges or access rights). Users shall be assigned to one of four pre-defined groups, or a custom user group shall have different level of access to system features. The system shall have the following pre-defined group access levels:
1. Administrator: Has access to all features of the system.
 2. Power User: Has access to all features except adding or deleting users.
 3. User Admin: Has access to view live video, search recorded video, and add and delete users.
 4. Restricted: Has access to view live video and search recorded video.
 - a. The User Group drop-down list shall also contain all custom User Groups that have been previously created. When a user selects a User Group, the Custom User Permissions and Custom User Privileges section shall display the permissions and privileges granted to that User Group. The Custom User Privileges section shall contain the following list of privileges that can be assigned to a user:
 - 1) Allow Live Viewing
 - a) Available in Live Cameras
 - b) Available in Live Groups
 - c) Available in Live Views
 - d) exacqReplay

- e) Allow PTZ
 - f) Include in Event Monitor
- 2) Allow Searching
 - a) Available in Search Cameras
 - b) Available in Search Groups
 - c) Available in Search Views
 - d) Available in Search Events
 - e) Save Image and Copy to Clipboard
 - f) Print Image
 - g) Burn Disc
 - h) Export Video
 - i) Smart Search
- 3) Configuration
 - a) User Admin
 - b) View Admin

2.3 VIDEO MANAGEMENT SYSTEM HARDWARE

- A. Server Requirements: The VMS server software shall operate on the following minimum required hardware:
 - 1. Processor: Intel® Celeron
 - 2. Graphics: 1280x1024x32 bits
 - 3. RAM: 2 GB
 - 4. NIC: 10/100BASE-T Ethernet
 - 5. Hard Disk:
 - a. Western Digital Enterprise Drives, WD RE4 SATA or WD RE SATA (or)
 - b. Seagate Barracuda ES.2 SATA
 - c. 30GB shall be reserved for the Operating System and VMS server software
 - 6. Operating Systems:
 - a. Linux Ubuntu 10.04
- B. Provide one (1) exacqVision IPS04-1000 - compact desktop IP Camera NVR Server
- C. Provide one (1) eight port Poe network switch - by Netgear

2.4 FIXED POSITION INTERIOR IP DOME CAMERAS

- A. The product specified shall be an all-in-one indoor/outdoor, vandal resistant dome enclosure with integrated H.264 (MPEG 4, Part 10) camera and varifocal lens providing HD720p resolution at full video frame rate of 30fps with audio. Dual encoders allow simultaneous viewing of both H.264 and MJPEG video streams, and shall conform to the ONVIF, and PSIA standards. The camera offers Lightgrabber™II for enhanced image sensitivity and DTS (Direct-To-Storage) recording. Requiring low power the camera is PoE (IEEE 802.3af) compliant. The camera offers Day/Night functionality with high sensitivity for use in low light indoor/outdoor applications. The dome camera is constructed of cast-aluminum and tamper resistant clear polycarbonate dome bubble with inner liner and is IP 66/NEMA4 rated.
- B. General Requirements:
 - 1. The IP dome camera shall be a high impact aluminum, vandal resistant, Day/Night color dome camera with a progressive scan CMOS sensor.
 - 2. The IP dome camera shall utilize a CMOS sensor that is 1/3-inch with a dichroic infrared mirror capable of producing HD720p resolution.
 - 3. The IP dome camera shall have no less than 1280(H) x 720(V) pixels.
 - 4. The camera shall be H.264 (MPEG 4, Part 10) compliant.

5. The IP dome camera shall provide H.264 (MPEG 4, Part 10) and MJPEG video compression with simultaneous streaming of both image formats.
6. The IP dome camera shall use Main Profile (MP) for mainstream consumer broadcast and storage applications.
7. The IP dome camera H.264 encoded video stream shall support full real time video frame rate of 30fps at a maximum resolution of HD720p (1280 x 720).
8. The IP dome camera MJPEG encoded video stream shall support full real time video frame rate of 30fps at a maximum resolution of HD720p (1280 x 720).
9. The IP dome camera shall be configurable to output images at the following resolutions from the webpage interface.
 - a. H.264 720p & MJPEG 720p
 - b. H.264 720p & H.264 480p
 - c. H.264 720p & MJPEG 480p
10. The IP dome camera shall be configurable to output images at the following resolutions when configured from the API interface.
 - a. H.264 720p & MJPEG 720p
 - b. H.264 720p & H.264 480p
 - c. H.264 720p & MJPEG 480p
 - d. H.264 720p & H.264 SIF
 - e. H.264 720p & MJPEG SIF
 - f. H.264 480p & MJPEG 480p
 - g. H.264 480p & H.264 SIF
 - h. H.264 480p & MJPEG SIF
11. The IP dome camera shall have bit rate control over the H.264 image stream.
12. The IP dome camera shall have a selectable bit rate from 256 Kbps to 11 Mbps for the H.264 image stream.
13. The IP dome camera shall have quality control over the MJPEG image stream with four selectable quality values from the webpage interface.
14. The IP dome camera shall have quality control over the MJPEG image stream with 86 selectable compression values from the API interface.
15. The IP dome camera shall conform to the ONVIF standard.
16. The IP dome camera shall conform to the PSIA standard
17. The IP dome camera shall be Power over Ethernet (IEEE802.3af Class1) compliant for indoor/outdoor applications.
18. The IP dome camera shall have an integrated 3-13mm megapixel IR corrected varifocal lens with F1.4, and 1/3" optical format.
19. The IP dome camera shall provide a cast-aluminum housing, polycarbonate dome and inner liner.
20. The IP dome camera shall provide protection against water and dust up to IP66 / NEMA4 standards.
21. The IP dome camera shall be designed to be surface mounted to a wall or ceiling and pendant or wall mounted with optional accessories.
22. The IP dome camera shall be designed to be mounted to a single or double gang outlet box with optional accessory.
23. The IP dome camera shall have a 3-axis gimbal with providing 360° pan, 90° tilt and 350° azimuth for easy camera positioning.
24. The IP dome camera minimum illumination requirement to produce an image in color mode will be 0.10 lux (0.01 fc) with an F1.4 lens.
25. The IP dome camera shall provide motorized IR filter that will automatically switch from color to monochrome enhancing low lighting or in applications where IR illumination is utilized.
26. The IP dome camera shall require less than 0.05 lux (0.005 fc) to produce a monochrome image when in night mode.
27. The IP dome camera shall be sensitive from 800nm to 940nm IR illumination.

28. The IP dome camera shall have a feature (Lightgrabber™II) that enhances camera sensitivity by increasing the integration time of the CMOS sensor.
 29. The IP dome camera shall provide automatic white balance, automatic exposure, gain control, electronic shutter, and backlight compensation.
 30. The IP dome camera shall provide user configurable saturation, contrast, brightness, and sharpness controls from the webpage interface.
 31. The IP dome camera shall provide a fully programmable motion detection area with adjustments for sensitivity and size to detect motion in various lighting conditions.
 32. The IP dome camera shall provide a video flip and rotate function to allow the image to be digitally rotated 180 degrees, or flip the image horizontally or vertically.
 33. The IP dome camera shall provide selectable AC Lighting control for 50Hz or 60Hz lighting.
 34. The IP dome camera shall transmit full duplex, bi-directional (two-way) audio that is synchronized with the H.264 video stream.
 35. The IP dome camera shall support DTS (Direct-To-Storage) for recording of time lapse and event recording using network attached storage.
 36. The IP dome camera shall have an event handler allowing the camera to send an image or video clip to an FTP site, email address, and or network attached storage when receiving an internally or externally generated event.
 37. The IP dome camera shall support the following licensed On-Camera IQapps.
 - a. IQaccess: Software that enables multiple users to receive alerts via a pop-up window when the camera receives a hardware or software trigger.
 38. The IP dome camera shall be FCC Part 15 Class B, CE, and RoHS compliant.
 39. The IP dome camera shall operate within an ambient temperature of -20°C (-4°F) - to +50°C (+122°F).
- C. The Interior Dome IP Camera shall be an IQinvision IQeye Alliance MX Series, IQM31NE-B5 - H.264, HD720p, Color Indoor/Outdoor Vandal Resistant Network Dome Camera with Integrated Lens. Provide in quantities as shown on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install system in accord with manufacturer's instructions.
- B. Wiring shall be provided and installed according to the standards specified elsewhere herein for CAT6 structured data cabling. Contractor must provide as built wiring diagrams to the School district.
- C. Wiring shall be tested according to CAT6 standards.
- D. Approximate wiring is indicated on the Contract Drawings. Installation shall be in accord with the equipment manufacturer's recommendations and requirements where they exceed CAT6 standards.

3.2 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Requirements: Testing and Inspection Services.
- B. Test in accord with NFPA 72H.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Section 01400 - Quality Requirements: Testing and Inspection Services.
- B. Include services of technician to supervise installation, adjustments, final connections, and system testing. Technician must be certified by the manufacturer. Equipment must be supplied by an authorized distributor of each item of equipment.
- C. Owner personnel shall be fully instructed on the use and programming of the system. Provide 8 hours of initial training to satisfy contract substantial use requirements. Provide 8 additional hours of training return sessions to train the Owner as desired during the warranty period.
- D. Manufacturer's representative shall coordinate with the Owner the operation of the system prior to final programming of the system. Configuration options shall be reviewed and documented.

END OF SECTION 282300

SECTION 283111

DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fire Alarm Control Equipment
- B. Manual Initiating Devices
- C. Automatic Initiating Devices
- D. Notification Appliances
- E. Fire Alarm Interface Modules

1.2 RELATED WORK/DIVISIONS

- A. Division 1
- B. Division 8
- C. Division 23

1.3 REFERENCES

- A. Pennsylvania Construction Code Act (Title 34)
- B. International Building Code
- C. NFPA 70 - National Electric Code as adopted by IBC
- D. NFPA 72 - National Fire Alarm Code as adopted by IBC
- E. International Fire Code
- F. International Mechanical Code
- G. International Electrical Code
- H. NFPA 101 - Life Safety Code
- I. NFPA 1 - Fire Prevention Code

1.4 SYSTEM DESCRIPTION

- A. Fire Alarm System: Non-coded, addressable microprocessor-based fire alarm system with initiating devices, notification appliances, monitoring and control devices, and connection to an approved Supervising Station.

1.5 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.

DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

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- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. A list of all equipment to be provided and installed in the system
 - b. Data sheets of all items to be provided with the specific item or model number highlighted
 - c. Required support documentation indicating the authorized relationship of the system supplier and copies of certifications and listings that are required in the specifications.
 - d. Fire Alarm Cable
 - e. Matrix of operation of the system
 - f. Standby battery calculations
 - 2. Upon approval of the submittal material, provide system drawings, prepared in AutoCAD, to include the following:
 - a. All control equipment with interconnecting wiring
 - b. Field connections of all circuits connecting to the control equipment
 - c. Floor layouts with fire alarm system device locations shown
 - d. Addressable device numbers for each addressable device
 - e. Notification appliances circuited and numbered, with candela setting for visual units and output setting for audible units
 - f. Typical device connections for each type device used in the system
 - g. Basic riser diagram to include control equipment and all field circuits
 - h. Indicate temperature settings of thermal detectors.
- C. Local Code Authority Submission: It shall be the responsibility of the Approved Equipment Supplier to provide the required materials and submittal data, including drawings, to the Local Authority Having Jurisdiction (AHJ) for their review and approval if necessary. Any fees for the submission and approval process shall be the responsibility of the installing contractor.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record of Completion: The equipment supplier shall complete the Record of Completion as required in NFPA 72. Any deficiencies that are to be listed on the Record of Completion shall be reviewed with the Architect/Engineer on record for the project before the authority having jurisdiction is requested to sign the document. Upon approval, the original copy of the completed Record of Completion, signed by all required parties, shall be submitted through the Contractor to the Architect/Engineer and Building Owner.
- C. Drawings of the completed system reflecting any changes that were made from the original submission of drawings.
- D. Copy of the system program in printed form and on a USB thumb drive.
- E. Operating and Instruction Manuals of the entire system.
- F. Copy of the Testing and Maintenance Agreement for the first year of service.
- G. Copy of the Supervising Station Monitoring Agreement.
- H. Copy of the Certificate for Listing or Placarding the system.
- I. System Program: The equipment supplier shall provide a copy of the latest system program in printed form and on a USB thumb drive.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Equipment Supplier: Shall be a local Company or local Branch office that is authorized by contract to provide all the products and equipment to be installed in the fire alarm and detection system. Upon request, a current letter provided within the past 30 days, shall be provided to the Architect/Engineer of the Authorized relationship between the Manufacturer and the Equipment Supplier. In addition, the Equipment Supplier shall have the following minimum certifications and listings:
 - 1. A minimum of one individual who works full time with the local office of the Equipment Supplier supporting this project who is NICET Certified in Fire Alarm Systems at Level IV or higher. A copy of a current Certification Certificate shall be included in the Submittal Data required above.
 - 2. The Equipment Supplier shall be listed by Underwriters Laboratories, Inc. (U.L.) under category UUJS for Protective Signaling Systems or Factory Mutual Research Approved (FM) for Fire Alarm Service - Local Companies under Standard 3011. A copy of a current Listing or Approved Certificate shall be included in the Submittal Data required above.
- C. Installer: Company specializing in installing the products specified in this section with minimum 3 years documented experience. Certified by the state and/or local governments as fire alarm installer when required by law. In lieu of the installers being certified when required by local AHJ, the Equipment Supplier shall be responsible for certifying the installation.

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70, NFPA 72 and locally-enforced codes.
- B. Furnish products listed and classified by UL, FM or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.
- C. Interconnecting equipment, initiation devices, notification appliance circuit extenders, and annunciating devices shall be UL listed to operate as a unit although manufacturers may differ.

1.9 MAINTENANCE SERVICE

- A. Inspection and Testing Agreement: As required for U.L. Certifying a Remote Supervising Station System, the Equipment Supplier shall furnish a full service Testing and Maintenance Agreement to support the system during the first year of operation or for one year from Date of first beneficial use of the system. During this period, the Equipment Supplier shall provide the following at no additional cost to the Owner:
 - 1. Required Inspections and Testing
 - 2. Emergency Service during normal working hours
 - 3. Certifying the system for Remote Supervising Station service
 - 4. First Year monitoring service through a U.L. Listed Supervising Station or other Supervising Station approved by the local AHJ or Owner.
 - 5. Repair or replacement of any required parts, provided they have not been abused or misused by abnormal conditions such as vandalism, fire, water damage, lightning damage or other abnormal conditions.
- B. Service Not Covered By Above
 - 1. Service or labor desired by the Owner outside normal working hours of Monday through Friday from 8:00 AM to 5:00 PM shall be charged at the Equipment Suppliers normal published rates.

2. Repair or replacement parts required due to abuse or other abnormal use, upon Owner approval shall be charged by the Equipment Supplier at published prices.

C. Service Agreement Renewal: The Equipment Supplier shall provide to the Owner at the time the system is turned over for first beneficial use, a Service Agreement Renewal proposal to cover the following:

1. Two (2) additional years for an Inspection, Testing and Maintenance Agreement to meet the current codes in effect.
2. The proposal shall include the cost for re-certificating (U.L.) or placarding (FM) the system for Remote Supervising Station Service.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Automatic Smoke Detector: Furnish 5 of each type and rating installed.
2. Heat Detector: Furnish 5 of each type and rating installed.
3. Manual Pull Station: Furnish 2 of each type and rating installed.
4. Audible Indicating Devices: Furnish 2 of each type installed.
5. Visual Indicating Devices: Furnish 2 of each type installed.
6. Audible/Visual Devices: Furnish 5 of each type installed.
7. Contact Interface Module: Furnish 1 of each type.
8. Keys: Furnish 6 of each type.

1.11 WARRANTY

A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS AND OPERATIONS

2.1 MANUFACTURERS

A. Provide a Fire Alarm and Automatic Detection System that is manufactured by a company that has a complete line of the products required for this project and has been successfully represented in this area for five years or more. Obtain fire alarm and automatic detection system components through one source from a single manufacturer who assumes responsibility for compatibility of system components. Following is a list of manufacturers that are known to meet these criteria. However, the specific equipment specifications and operations of the system to be provided for this project and the qualifications of the Authorized Representative (Equipment Supplier) of the manufacturer must meet or exceed the specifications to be considered for approval.

1. Siemens Fire Safety
2. Edwards Systems Technology
3. Notifier
4. Simplex Grinnell

2.2 FIRE ALARM AND AUTOMATIC DETECTION CONTROL UNIT

A. Control Panel: Modular construction with flush or surface wall mounted enclosure as indicated on the Drawings.

B. Power supply: Shall be an integral part of the control equipment and include primary and secondary power circuits. The secondary supply shall automatically supply power to the system upon loss of primary power. The secondary power shall be sized to meet the Remote Station requirements of 60 hours of system operation under maximum quiescent load, plus 5 minutes of full load operation

under an alarm condition. Provide power supplies and batteries with a minimum of 20% spare capacity. These secondary power capacities shall apply to all remote controls, alarm extender panels, supervising station reporting units and other ancillary controls provided with the system. Provide dedicated 24 volt DC power supplies for all magnetic door (smoke door) hold-open devices.

1. If the system is certified as a Central Station System, the battery standby may be reduced to 24 hours of stand-by power capacity.
- C. System Supervision: All initiating device circuits, notification appliance circuits, and ancillary circuits shall be supervised as class B circuits. All end-of-line device locations shall be clearly marked on the drawings.
- D. Initiating Device Circuits: Signaling line circuits shall be limited to a maximum of 60 devices without short-circuit protection. Circuits over 60 devices shall require circuit isolation modules to prevent short-circuits from affecting more than 60 devices. Each initiating device circuit shall be loaded to not more than 80% of its maximum number of addresses.
- E. Notification Appliance Circuits: Supervised notification modules, shall be installed as class B circuits with end-of-line device locations clearly marked on the drawings. Load signal circuits and modules to not more than 80% of rated capacity.
- F. Notification Appliance Circuit Supervision: All visual notification appliances throughout the facility shall be synchronized. All audible notification appliances throughout the facility shall be synchronized and operate on the temporal code 3 pattern. Visual and audible notification appliances shall be controlled independently allowing either to be silenced or operated manually at the control unit.
- G. Supervising Station Signal Transmitter: Provided as part of the system, shall be a Digital Alarm Communications Transmitter (DACT) that is capable of reporting the following signals to a U.L. Listed Supervising Station:
1. Alarm Conditions
 2. Trouble Conditions
 3. Supervisory Conditions
 4. Provide capability to provide additional signals as required by the AHJ.
 5. The DACT shall be installed to meet the requirements of NFPA 72 with 2 telephone line connections, and 24 hour standby power as required for Remote Station Supervising Station reporting. The system shall be programmed to report, as a minimum, every 24 hours to the Supervising Station and shall alternate telephone lines for reporting purposes. Unless otherwise directed by the Building Owner, the equipment supplier shall provide the connections to the supervising station and include the first year monitoring fee as part of this contract. The Building Owner shall be responsible making the 2 telephone lines available for connection to the DACT and provide a list of personnel to be contacted by the Supervising Station should the need arise. This contractor shall wire, connect, and test the operation of the DACT.
 6. If the system is certificated as a Central Station system, the battery standby may be reduced to 24 hours of standby power capacity.
 7. Project shall include one years annual monitoring of the Fire Alarm System. Monitoring shall be provided by a UL listed, approved Central Station. The Central Station shall be approved by the Professional Engineer and authority having jurisdiction, and include required daily test reporting.
- H. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts to provide accessory functions specified. The relay control wiring shall be electrically supervised by the Fire Alarm System to within three feet of the device or equipment to be controlled.

- I. The front panels of all Remote Annunciators shall include Operator controls for ALARM, TROUBLE and SUPERVISORY ACKNOWLEDGE/SILENCE, NOTIFICATION APPLIANCE SILENCING, NOTIFICATION APPLIANCE RESOUND, and SYSTEM RESET. These operations shall be protected in order that only personnel with equipment keys have access to these functions.
- J. Trouble Sequence of Operation: Any "TROUBLE" condition in the system shall cause the following system operations:
 - 1. Indicate an alphanumeric message on the Main Control Unit and all Remote Annunciators of the specific trouble condition.
 - 2. Cause an audible trouble signal and "trouble" Lamp or LED to operate on the Main Control Unit and all Remote Annunciators. The audible trouble signal may be silenced, but the visual signal shall remain on until the trouble is corrected and the system is reset.
 - 3. Cause a "trouble" signal to be transmitted to the Supervising Station.
- K. Alarm Sequence of Operation: Any "ALARM" condition in the system shall cause the following system operations:
 - 1. Indicate an alphanumeric message on the Main Control Unit and all Remote Annunciators of the specific device that caused the "Alarm" condition
 - 2. Cause an "Alarm" Lamp or LED to operate on the Main Control Unit and all Remote Annunciators. The "Alarm" lamp or LED shall remain on until the device and system is reset.
 - 3. Cause all notification appliances in the facility to operate, unless the specifications and/or drawings indicate zone or floor control of notification appliances.
 - 4. Cause an "Alarm" signal to be transmitted to the Supervising Station. The signal shall remain operated until the system is reset at the Main Control Unit or Remote Annunciators.
 - 5. Operate the following control functions if applicable:
 - a. Elevator recall to main floor and alternate floor as required by the AHJ
 - b. Allow all doors held open by door holders to close depending on the zone in alarm.
 - c. If a duct detector is in alarm, cause it's respective air handling unit fan to shutdown. The duct detector in alarm shall be programmed as a "supervisory" function per NFPA 90A, unless otherwise required to report as an alarm condition by the local AHJ.
 - d. Any security or access-controlled doors or gates shall be released as required by the local AHJ or Building Owner Representatives.
 - e. Output contact to lighting control panel input to enable selected lighting.
- L. Supervisory Sequence of Operation: Any "SUPERVISORY" condition in the system shall cause the following system operations:
 - 1. Indicate an alphanumeric message on the Main Control Unit and all Remote Annunciators of the specific "Supervisory" condition.
 - 2. Cause an audible "Supervisory" signal and "Supervisory" Lamp or LED to operate on the Main Control Unit and all Remote Annunciators. The audible "Supervisory" signal may be silenced, but the visual signal shall remain on until the "Supervisory" condition is corrected. Upon correcting the "Supervisory" condition, the "Supervisory" signal shall resound and require acknowledgement. The system can then be reset.
 - 3. Cause a "Supervisory" signal to be transmitted to the Supervising Station upon activation and the back-to-normal condition.
 - 4. Supervisory conditions shall include, but not limited to, the following conditions as they apply to this project:
 - a. Sprinkler system valve tamper/shutoff and PIV switches
 - b. Sprinkler system fire pump signals (minimum of 3 signals)
 - c. Sprinkler system valve room - low temperature
 - d. Duct detectors, unless directed otherwise by the local AHJ.
 - e. Other conditions as listed in these specifications, shown on the drawings or as directed by the local AHJ.

- M. Function Switches: Included on all Remote Annunciators shall be a minimum of 12 manual function switches or pushbuttons that can be programmed to include the items listed below and other functions required in these specifications, shown on the drawings or desired by the Building Owner:
1. System DRILL function
 2. Bypass Supervising Station Alarm Functions ONLY - Trouble and Supervisory conditions shall continue to report to the Supervising Station
 3. Bypass Audible Notification Appliances
 4. Bypass Visual Notification Appliances
 5. Bypass Door Holders
 6. Bypass all Smoke Detectors
 7. through 12 - programmed per the requirements of the specifications, drawings, local AHJ requirements or Building Owner
 8. Operation of any of the above function switches shall cause a "trouble" condition on all Remote Annunciators and cause a report to the Supervising Station. The function switch operation shall be accessible through locked cabinet doors or other acceptable protection to limit access to authorized personnel only.
- N. Control Equipment Display: All Remote Annunciators shall contain a minimum 80 character alphanumeric display for indicating all system alarm, supervisory, trouble and system functions. A minimum of 32 characters shall be capable of being custom programmed for displaying alarm, supervisory and trouble conditions.

2.3 MANUAL PULL STATIONS

- A. Description: Addressable single-action pull-lever type with integral addressable module, arranged to communicate manual station status (normal, alarm, or trouble) to the FACP. Fabricated of plastic, and finished in red with molded raised-letter operating instructions of contrasting color. Station shall show a visual indication of alarm. UL 38 Listed.
- B. Station Reset: Key or wrench operated switch.
- C. Mounting: Semi-flush (where possible) or surface mounted. Provide manufacturer's standard backbox for surface locations that match the manual station.
- D. Indoor Protective Shield: Factory fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. [Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.]
- E. Weatherproof Pull Stations: Where indicated or required because the environmental conditions (including temperature and humidity) can become outside the listed ratings of a standard pull station, provide the following:
1. Provide manual pull stations that are suitable for the environment in which they are installed.
 2. If a non-addressable device is required, locate an addressable interface module in an accessible location within the listed environmental conditions of the module and as close as possible to the device.

2.4 SPOT TYPE AUTOMATIC DETECTION

- A. Description: All devices shall be UL listed. Include features and meet requirements as follows:
1. Detectors shall be documented as compatible with the control equipment to which they are connected. Detectors shall be listed for the application indicated (i.e. ceiling, wall, below access floor, etc.)

2. The environmental conditions (including temperature and humidity) of each detector location shall be within the detectors listed ratings. If the detector will be exposed to environmental conditions outside of its listed ratings, provide a device that is suitable for the environment in which it is installed. If a non-addressable device is required, locate an addressable interface module in an accessible location within the listed environmental conditions of the module and as close as possible to the device.
 3. Detectors installed in air plenums shall be listed for the air velocities present.
 4. Spot type smoke and heat detectors shall fit into a base that is common for both types of detectors.
 5. Within one year of substantial completion, upon request of the Owner, and as approved by the AHJ replace any detector with an alternate type. Allow for a maximum of 5% of the total detectors installed but not less than 5.
- B. Indoor Protective Shield: Factory fabricated wire guard to protect the automatic detector from physical damage. UL listed for use with the automatic detector.

2.5 SPOT TYPE SMOKE DETECTORS

- A. Description: Addressable photoelectric-thermal type with the capability to program the detector for specific hazard profiles. The detector shall be intelligent and be able to determine the difference between actual fire conditions and deceptive phenomena such as dust, steam, aerosols, and other non-fire conditions. The detector shall be immune to false alarms, capable of automatically adjusting sensitivity to match the environment, and provide alarm verification.
- B. Communications: The detector shall provide bi-directional communications with the FACP. The control panel shall be capable of analyzing the signal from the detector's analog value for calibration, sensitivity, and address identification. The detector's sensitivity or application setting for specific hazard profiles shall be individually controlled by the FACP. If the detectors sensitivity becomes beyond an acceptable level for a predetermined duration, a trouble signal shall be initiated.
- C. Coverage Area: 900 square feet.
- D. In addition to the detection capabilities, the spot type smoke detectors shall include the following:
1. Capability of programming the smoke detector for reporting alarms from smoke conditions only, abnormal thermal conditions only, or a combination of both.
 2. Capability of programming the smoke detector for alarm verification.
 3. Testing the smoke detector in the field before installation on a fixed or portable test unit for proper operation.
 4. An LED or multiple LED's that indicate a "normal" condition with one color LED and an "alarm" condition with a red blinking or steady LED.
 5. Capability of adding the following auxiliary functions:
 - a. Relay base assembly for controlling local functions. The relay shall be independently programmable from the smoke detector.
 - b. Remote LED operation for the smoke detector alarm condition.
 - c. Audible base assembly that is programmable to operate when the smoke detector is in alarm condition or from any other alarm condition in the system.

2.6 SPOT TYPE THERMAL DETECTORS

- A. General: Thermal detectors shall be provided that are appropriate for the area installed and are addressable and programmable. It shall be the responsibility of the Equipment Supplier to provide the lowest temperature setting and operating characteristics of all spot type thermal detectors to provide the earliest detection of abnormal heat without unwanted alarms. If the incorrect temperature setting is installed, during the first year of operation, the Contractor shall be responsible for replacing the unit with the correct temperature device. In all cases, each spot type thermal detector shall report as individual addressable points on the system.
- B. Addressable Combination Fixed Temperature/Rate-of-Rise Detectors:
 - 1. Addressable self restoring combination Fixed Temperature and Rate-of-Rise. Fixed temperature element shall be rated for 135°F and 15° per minute rate-of-rise. Capability shall be provided to disable the rate-of-rise feature and allow the detector to perform just fixed temperature detection. Coverage area shall be 2500 square feet.
- C. Non-Addressable Devices:
 - 1. Install non-addressable devices only where the location exceeds the environmental ratings of the addressable devices. For each non-addressable device, provide an addressable interface module in an accessible location within the listed environmental conditions of the module and as close as possible to the device.
 - 2. Fixed Temperature/Rate of Rise Detectors: Fixed temperature element shall be rated for 135 or 200°F and 15° per minute rate-of-rise. Coverage area shall be 2500 square feet.
 - 3. Fixed Temperature Detectors: Fixed temperature element shall be rated for 135 or 200°F. Coverage area shall be 625 square feet.
 - 4. Rate Compensation/Fixed Temperature Detectors: Self restoring and rated either 135 or 200°F. Coverage area shall be 2500 square feet. Detectors shall be totally enclosed and weatherproof for installation in extremely dusty, wet, or humid locations.
 - 5. Other non-addressable thermal detectors may need to be provided for locations requiring higher temperature ratings.

2.7 DUCT MOUNTED SMOKE DETECTORS

- A. Description: Addressable, photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions.
- B. Duct smoke detectors shall include the following:
 - 1. Duct mounted smoke detectors shall be provided with the same capabilities and functions as the spot type smoke detectors.
 - 2. Duct detector housing shall consist of a base which is common to the spot type automatic detection devices.
 - 3. The duct detector shall be rated for the air velocities, temperatures, and humidity expected during normal operation of the air handling system.
 - 4. The housing shall contain test ports for measuring airflow and testing.
 - 5. Auxiliary relay(s) shall be provided for the shutdown of the associated air handling unit(s). Locate this relay within 3' of the units control panel or starter.
- C. Remote Indicator: Provide remote indicators as required. All duct smoke detectors installed in concealed spaces shall be provided with a remote indicator consisting of alarm LED installed below the unit in order to facilitate locating the unit for testing and maintenance purposes. Coordinate remote indicator locations with Owner/Engineer before roughing-in.

- D. Weatherproof Enclosures: Where indicated or required provide enclosure complying with NEMA 250 requirements for Type 4X. Where subject to ambient temperatures below the rating of the duct smoke detector, provide insulation, strip heater, power supplies and thermostat.

2.8 PROJECTED BEAM SMOKE DETECTORS

- A. Description: Infrared light obstruction smoke detector consisting of a separate transmitter and receiver or transmitter/receiver and reflector. The beam shall cover an area 30' wide and between 30' and 280' long.
- B. Projected beam smoke detectors shall include the following:
 - 1. Field settable sensitivity settings.
 - 2. Each projected beam smoke detector shall have an associated addressable monitor module to report alarm and trouble conditions to the fire alarm control panel.
 - 3. The detector shall distinguish between smoke and accidental beam blockage. Beam blockage shall report a trouble signal to the fire alarm control panel.
 - 4. The detector shall automatically adjust for ambient influences including dirt and dust.
 - 5. If a reflector is used, it shall be of the size and type as provided by the manufacturer.
- C. Remote Test Stations: Provide remote test stations as required. All projected beam smoke detectors installed in a concealed space shall be provided with a Remote Test Station consisting of alarm LED and test switch installed below the transmitter in order to facilitate locating the unit for testing and maintenance purposes.
- D. Indoor Protective Shield: Factory fabricated wire guard to protect the beam smoke detector from physical damage. UL listed for use with the beam detector.

2.9 ADDRESSABLE INTERFACE MODULES

- A. Description: Addressable Interface Modules provide a means of interfacing for monitor or control of non-addressable devices to the fire alarm system.
- B. Addressable Monitor Modules: Provide means to monitor the status of a normally open or closed contact. Some functions that require addressable monitor modules include:
 - 1. Sprinkler System
 - 2. Kitchen Hood Systems Monitoring
 - 3. Ancillary Fire Protection Systems
 - 4. Knox Box
 - 5. Non-Addressable Devices
- C. Addressable Control Module: Provide means to control equipment using a form C relay consisting of one normally open and one normally closed contact. Contact rating shall be as required for control function. Some functions that require addressable control modules include:
 - 1. Smoke Door Holder Control
 - 2. Air-Handling Unit Control
 - 3. Smoke Control Functions
 - 4. Elevator Controls
 - 5. Security, Access-Controlled Doors and Gates
 - 6. Ancillary Fire Protection Systems
- D. Addressable interface modules shall include the following:
 - 1. The interface modules shall be individually addressable and custom programmed for the items they monitor or control

2. The interface module shall mount on a 4" square outlet box and be provided with a faceplate.
3. Each module shall be provided with a label identifying the address and the control or monitor function.
4. Modules shall include a status LED identifying normal condition, unit malfunctioning, and change of state.

2.10 NOTIFICATION APPLIANCES

- A. Description: UL listed horn and visual units for fire alarm notification.
- B. Mounting: Wall mounted (or ceiling mounted where approved by the AHJ). Semi-flush (where possible) or surface mounted. Provide manufacturer's standard back box for surface locations that match the notification appliance.
- C. Indoor Protective Shield: Factory fabricated wire guard or clear plastic enclosure to protect the notification appliance from physical damage. UL listed for use with the notification appliance.
- D. Weatherproof Notification Appliances: Where indicated or required because the environmental conditions (including temperature and humidity) can become outside the listed ratings of standard devices, provide weatherproof notification devices suitable for the environmental conditions in which it is installed.
- E. Color: White with red lettering unless directed otherwise by Architect.

2.11 AUDIBLE NOTIFICATION APPLIANCES (SPEAKERS)

- A. UL 1480 listed fire alarm speakers.
- B. Field Selectable Taps: 1/8, 1/4, 1/2, 1 and 2 Watts
- C. Field Selectable Taps for large spaces or spaces with high average ambient sound levels: 1/2, 1, 2, 4 and 8 Watts.
- D. Audible devices shall meet the requirements of voice intelligibility per NFPA 72.

2.12 VISUAL NOTIFICATION APPLIANCES

- A. Xenon strobe lights with clear polycarbonate lens and the word "FIRE" is engraved in minimum 1" high letters. UL 1971 listed.
- B. Field Selectable Candela Settings:
 1. Wall: 15/30/75/110
 2. Ceiling: 15/30/75/95
- C. Field Selectable Candela Settings for large rooms and spaces:
 1. Wall: 135/185
 2. Ceiling: 115/177

2.13 KNOX BOX

- A. Provide a flush mounted Knox Box at location where required by local AJH, fire marshal, fire chief, etc. and meeting their key requirements. Surface mounted will be acceptable in existing walls. Connect to fire alarm system with a monitor module to provide a supervisory condition.

2.14 REMOTE ANNUNCIATOR

- A. Mounting: Flush or surface mounted with matching surface box designed for the unit as indicated or required.
- B. LCD Annunciator: Duplicate annunciator functions including all switching, function switches, and keypad as the fire alarm control panel. Annunciator shall be capable of monitoring the entire system and full system control. Provide one (1) where indicated on the Drawings.

2.15 FIRE ALARM CABLE

- A. Manufacturers:
 - 1. Belden
 - 2. West Pen
 - 3. General
- B. Non-Power-Limited Circuits: Solid copper conductors with 600-V rated, 75°C, color-coded insulation. Wire type and sizes shall be as recommended by manufacturer.
- C. Power-Limited Circuits: NFPA 70, Types FPL, FPLR or FPLP. Wire type and sizes shall be as recommended by manufacturer.
- D. All fire alarm cable shall be plenum rated.

2.16 WIRING METHODS

- A. Wire Routing: Route all device wiring from each device up into ceiling cavity within metallic conduit in recessed or unfinished areas or within surface raceway for renovated non-fishable areas. Stub all conduits into ceiling cavity and provide protective bushing for each.
- B. Cable Routing: Route cable for all device wiring within accessible ceiling cavities. Install in bridle rings at 4' spacing maximum. No cabling is to lie on or attach to ceiling tile, ducts, pipes, conduits or ceiling suspension wires, rods or structural members. Provide conduit stubs from devices and panels to the ceiling cavities.
- C. Route all fire alarm wiring from fire alarm panel within metallic conduit up into nearby ceiling cavity and connect to the wiring system indicated in A and B above. Provide bushings at conduit ends.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Manufacturer's Installation Requirements: Install products in accordance with manufacturer's instructions and the minimum requirements of the latest edition of the National Electric Code (NEC), NFPA 72 and IBC.
- B. Mounting Heights: All devices shall be mounted at heights indicated below or as otherwise noted on the drawings:
 - 1. Pull stations: 42 to 44" above finished floor to operating handle or lever.
 - 2. Audible and Visual Notification Appliances: 80" to 96" above finished floor.
 - 3. Audible and Visual Notification Appliances-Special Circumstances:
 - a. Multipurpose Room: 96" above finished floor.

- b. Library: 96" above finished floor but not less than 6" below ceilings and soffits.
- C. Minimum Wire Size: Use 16 AWG minimum size conductors for fire alarm detection and signal circuit conductors.
- D. Color Coded Wires: Provide fire alarm circuit conductors with insulation color coded or use colored tape at each conductor termination and in each junction box. Numbered wires may be substituted for color coded wires. Show numbers or color code on system wiring diagram.
- E. End-of-Line Devices: Mount end-of-line device in box with last device or separate box adjacent to last device in circuit. Indicate the exact location of the end-of-line device on the as-built drawings.
- F. Connections to Auxiliary Devices: Provide conduit and wiring connections to door release devices, door hardware packages, fire suppression system control panels, motorized smoke dampers and security systems.
- G. Trim Rings: Provide trim rings where flush mounted initiating and signaling devices do not completely cover the opening in the wall or ceiling surface.
- H. Telephone Lines: Provide two telephone lines directly to telephone terminal board for direct connections to outside lines for connection of the DACT by the contractor responsible for telecommunications.
- I. New Panel Power: Provide 1P-20A breaker in closest normal panel and connect to main fire alarm panel with 2 #12 + 1 #12 grd in ¾" conduit unless otherwise indicated.
- J. Additional panels added by manufacturer: Provide 1P.20A breaker in closest normal panel and connect to additional panel with 2 #10 + 1 #10 gnd in ¾" conduit unless otherwise indicated.
- K. Interconnection to Lighting Control System: There shall be an interconnection to the Lighting Control System. Provide fire alarm IM relay to initiate dry contact closure on Lutron Panel.
- L. Notification appliances shall meet all applicable codes. Notify the engineer of any problem areas before installation commences. The engineer will review all recommendations for the potential problem areas and advise in writing if additional items or changes are required. Any additional devices required after this point of the project are to be provided at no additional cost to the project.
- M. Measure ambient sound levels once the building is occupied and adjusts audible device tap setting to meet all applicable codes. Tap settings shall be field adjusted to the lowest tap that meets code. Tap settings shall be indicated on the installation and record drawings.
- N. Locate strobe devices at locations indicated on the drawings. A device is only to be relocated if the device is in conflict with casework, equipment, etc. Do not center strobes on walls unless indicated to do so. Set field selectable strobe settings to meet applicable codes. Settings shall be indicated on the installation and record drawings.
- O. Install automatic detection so it does not exceed the listed spacing and meets the requirements of NFPA 72. Do not locate automatic detection closer than 3' from HVAC grilles.
- P. Install the elevator smoke detectors, heat detectors, and control circuits per NFPA 72 and all applicable codes.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 260010.
- B. Acceptance Testing: A 100% Acceptance Test shall be conducted by the Approved Equipment Supplier to meet the requirements of NFPA 72 Chapter 7. The Record of Completion shall indicate the total number of items tested in the system.

3.3 AUTHORIZED EQUIPMENT SUPPLIER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 260010.
- B. Include services of certified technician to supervise installation, adjustments, final connections, and system testing as required by local codes.
- C. Program the actual owner-assigned room names/numbers for alarm location indication on displays. System is not considered acceptable with architectural or manufacturer assigned numbers for spaces and devices. In addition, the Equipment Supplier shall reprogram the labels in the system at no charge during the first year of operation as desired by the Building Owner.

3.4 DEMONSTRATION AND TRAINING

- A. Provide systems demonstration under provisions of Section 260010.
- B. The equipment supplier shall provide on-site training of representatives of the building owner. The training sessions shall be scheduled to meet the desired times of the Owner and shall be limited by time or number of sessions. The project professional shall be advised of these sessions in order that they may attend if desired. Documentation shall be provided indicating the topics covered, the names of those in attendance, date and time of the training session.

3.5 WARRANTY

- A. The entire system shall be under warranty for a period of one year from date of first beneficial use by the Owner. The warranty shall include all wiring, installation, labor and equipment providing the system has not been abused, subject to abnormal use, vandalized, damaged from fire, water, lightning or other abnormal use of the system.
- B. Warranty Includes: The warranty shall include the on-site labor, travel and equipment repair or replacement of all items not operating properly. The warranty covers normal working hours of Monday through Friday, from 8:00 Am to 5:00 PM, excluding Holidays. Work desired by the Owner outside these hours for warranty repairs or other work shall be invoiced at the Equipment Supplier's normal published rates

3.6 SEQUENCE OF OPERATIONS

- A. Upon a duct mounted smoke detector alarm condition, the auxiliary relay provided with the smoke detector shall be wired by the electrical contractor to the mechanical equipment's starter and shut down its respective unit. An alarm or trouble signal shall be sent to the fire alarm control panel.

3.7 TOWNSHIP/FIRE MARSHAL DRAWINGS

- A. The Contractor shall provide CAD Drawings on 11" x 17" sheets showing all device locations with identification numbers attached. These drawings shall show all devices within the building. These drawings shall be turned over to the township representative/fire marshal for their approval.

END OF SECTION 283111